Analysis of the Excitation of Synchronous Machines—*Economics of Steaming Equipment in Electric Generating Stations and Other Engineering Articles on Operating Practice*

Electrical World

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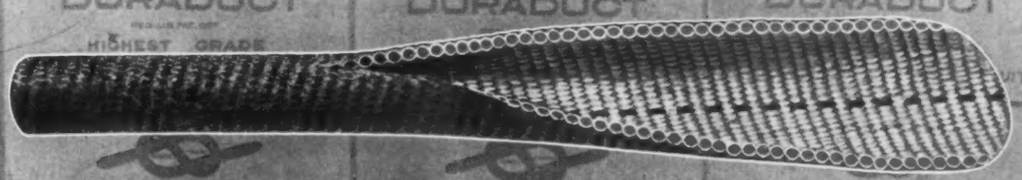

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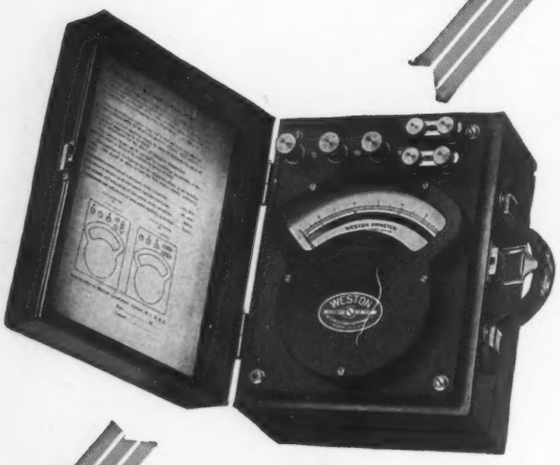

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The Enigma of Monopoly

ELSEWHERE in this issue we present information supplementary to that published last week on concentration of control of public utilities as given in the report of the Secretary of Agriculture. The Forest Service is at pains to show just to what extent the developed power of the various states is monopolized by a few corporations, and the data are quite impressive to the government at least. But why was not advantage taken to magnify the record still more? If monopoly is such a terrible thing, why not single out the monsters and show them in their most hideous form? A certain company in Illinois, for instance, is quoted as controlling 55.6 per cent of the total developed power of that State. This does not appear to be so bad when compared with a certain corporation in Utah which controls 84.3 per cent of the total power of that State. However, as a matter of fact, the Illinois company turns out more electrical energy than all of the central stations in Wyoming, South Dakota, New Mexico, Louisiana, Arkansas, Virginia, Mississippi, Florida, Delaware, Maryland, Arizona, Wisconsin, Vermont, New Hampshire, Nevada and Oklahoma combined. And yet this company, which must appear to be an awful monster to the government, is one of the most beneficial and vital forces in the upbuilding of industrial Chicago. In character and scope of its service it is without question the most advanced lighting company in the world. Nevertheless, however highly it may be regarded by the inhabitants of Chicago, however cheaply it may supply electrical energy to its manufacturers, however much it may share its earnings with the great city in which it operates, its existence is viewed with apprehension by the national government. Here is an enigma. Do men gather grapes of thorns and figs of thistles? Apparently the government believes they do.

The Rising Copper Market

THE continued advance in the copper market destroys all the traditions upon which the electrical industry has been accustomed to act in its dealings in the red metal. Before the war the large buyers for electrical consumption figured that if the price of electrolytic copper rose above 18 cents per pound it would not remain there long. But the value of these calculations, based on other conditions, has disappeared under the extraordinary stress of world conflict. Now, in addition to the enormous demand for the manufacture of munitions of war there is a domestic demand for peaceful purposes which is very large and still growing rapidly. Certainly the need for copper in the electrical industries is undergoing no shrinkage; on the contrary, it has increased apace with the improvement in business conditions. If supply and demand operate to elevate the price still higher, the electrical industry cannot combat the facts. Improvements will continue, but the new level of material prices means that the relation of the high cost of material to total costs must be carefully analyzed, and that when the public asks additional service there will be an investigation to show how profitable the proposed contracts will be and how long the demand is likely to continue.

Business Factors in Motor Drives

AN exhaustive study of the motor-drive and heating requirements of a textile mill at present run by three steam engines totaling 492 hp. has recently been made by the engineering department of a central station. This engineering investigation disclosed certain factors that seem worth emphasizing because they are not thought of always as bearing on the problem. It was found that by the installation of twenty-eight motors in place of the existing steam units there would be a saving of 57.8 hp. on a 145-hp. friction load. The motors range in capacity from 3 hp. to 50 hp. and total 507.5 hp. in connected load. Without going into the details of financial saving worked out for the electric drive (the engineers of the central station, of course, did this), it is interesting to note that the installation of central-station service will enable the mill to utilize 850 sq. ft. of floor space for production hitherto rendered of no avail through the obstruction of main belt drives from the engines. This is 1.12 per cent of the total productive mill area and means a possible increase in yearly output of 4 tons of spun material. Viewing the electric drive from this aspect gives the mill owner a new insight into the possibilities of purchased energy accompanied by a reconstruction of his power installation. Again, the point made in the report that only one-twenty-eighth of his establishment would be shut down in case of a temporary failure at one motor compared with a shut-down of one-third in the event of engine failure was well received. It is a mistake for central-station power engineers to overlook expressing the general advantages of the electric drive from purchased energy in completing reports of this kind, since in many cases the points which may be emphasized are fresh to the factory owner, trite as they may appear to the electrical man. Wherever an arithmetical value can be placed upon any of these general advantages, thereby making them more specific, the power report becomes correspondingly strengthened. More and more the

manufacturer is looking to the central station for analyses of greater refinement in studying his power situation, and the proper handling of prospective customers with large and complex establishments is indeed a task for the specialist, worthy of the best efforts of the central-station power-engineering department and offering the reward of a substantial volume of business if even a modest difference can be shown yearly in favor of central-station service.

The Excitation of Synchronous Machines

DIRECT-CURRENT generators are always expected to have inherent regulation of terminal voltage under varying loads. They are shunt-wound, compound-wound or overcompounded to meet the conditions of each particular case. It is ordinarily not supposed to be necessary to watch and readjust the terminal voltage of such machines when changes of load occur.

When alternating-current generators first came into use an effort was made to have inherent voltage regulation in their operation. At the best, however, it was found impracticable to obtain a degree of inherent regulation such as even a direct-current shunt machine of similar capacity could offer. Moreover, alternators so constructed as to maintain close automatic pressure regulation were likely to become dangerously overloaded in the event of an accidental short-circuit near the machine terminals. The recent tendency in construction has, therefore, been away from close inherent pressure regulation, relying upon either automatic or manual regulating devices for adjusting the field excitation under varying loads.

The article by Theo. Schou this week discusses the principles of field excitation with respect to the voltage of synchronous alternators under variations of load and power-factor, and also with respect to the behavior of synchronous motors under variations either of load or terminal voltage.

The novel features presented in the article are put forward in Figs. 5 and 6. It is easy to understand that the percentage of alternator capacity in an exciter should diminish as the capacity of the alternator increases. It is also easy to understand that the percentage in the exciter should diminish as the speed of the alternator increases. It is not, however, easy to see why the percentage should fall off as the 0.5th and 0.6th exponents respectively, with corresponding relations in the "cold" field-winding resistance.

Test of a Mechanical Stoker

THE brief account of the test of an underfeed stoker made by W. G. Claytor and S. S. Williams at the plant of the Roanoke (Va.) Railway & Electric Company gives some exceedingly practical information regarding methods and results. It is particularly to the point as showing the economy attainable in applying the stokers to an old plant, taken, as it was, without any of the somewhat impracticable refinements often introduced into tests of an entirely new equipment. The boiler and furnace plant was merely overhauled to see that it was clean, the steam gage tested, and a steam-flow meter installed to measure the steam produced. The first readings were taken with full load on and full fires on the grates, and thereafter readings were repeated every fifteen minutes, while samples were taken from each lot of coal weighed for the purpose of analysis. The ash was determined by the very practical process of weighing all the accumulation of the ash pit for the period of the test. The results of the run with the new stokers was very gratifying. An equivalent evaporation of 10.72 lb. of water per pound of dry coal was obtained when pushing the boilers to more than two and a half times their nominal rating and burning 36.6 lb. of coal per square foot of grate per hour. The corresponding equivalent efficiency of the combination of boiler, furnace and grate was a little over 74 per cent, certainly an exceedingly good record. The coal consumption per kilowatt-hour was nothing to brag of, being 2.26 lb. without the auxiliaries, but considering the fact that the turbines are of rather old pattern and of only moderate capacity they did perhaps as well as was to be expected, particularly since the vacuum was not good—only a trifle over 27 in. The main point of the test is the excellent efficiency of the production of steam, showing the very material advantage to be derived from using mechanical stokers even on a relatively small plant. In these days of somewhat precarious labor conditions the mechanical stoker may very properly find its way into many plants which in former years would hardly have seemed worth while changing over to automatic firing. All the tendencies now effective in plant design point toward a steady decrease in dependence upon hand-firing, and such tests as the one before us accelerate the march of progress.

Closer Thinking on Furnace Auxiliaries

A VERY sane viewpoint on the conditions of economy in stokers, economizers and superheaters is found in the paper by A. A. Potter and S. L. Simmering in our current issue. Their investigation indicates particularly the correlation of savings with cost and upkeep in these classes of apparatus. The authors point out, for instance, the percentage of labor saving by the use of mechanical stokers and roughly their probable cost and upkeep. The actual results are somewhat dependent upon the class of fuel used, but this again influences the amount of labor, so that the averages perhaps may be trusted as a fair approximation. With respect to economizers the situation is somewhat different, for here the saving is not in labor but in thermal units, which can be reckoned with greater certainty. One suggestion which the authors make with respect to the installation of economizers strikes us as being particularly sound. They recommend installing the plant on the unit plan with a separate economizer for each boiler. The results reported from this practice are good, and it would seem a sound proceeding in large plants as tending to the most efficient use of the apparatus. There seems to be no good reason why in a plant big enough

to have a sufficient number of large units to distribute the output properly under varying load the whole installation should not be upon a unit plan. It is very questionable whether elaborate cross-connected steam piping and other provisions for interchangeability do not cost more than they come to in the long run. As regards superheaters, the practical information given by the authors is much to the point. We have been somewhat overcautious in this country in the employment of superheat. It is only within a very few years that more than very slight superheating was looked upon as really sound practice. In point of fact the gain in economy is so considerable as to make the practice extremely desirable, particularly as it can be applied with great effect to comparatively simple engines as well as to steam turbines. In fact, with high pressure and superheat well within the bounds of safe practice, a simple engine of moderate speed may be pushed to an economy at least as great as that obtainable by a turbine of similar moderate output. Practical engineers will do well to bear in mind the last paragraph of the paper before us, pointing out that superheated steam requires first-class fittings in the use of steel, and to cause these to be recommended in such cases, as well as better and heavier pipe than is commonly employed. All this again points to the good features of simple design which minimize expensive auxiliaries.

Physical Photometry

A RECENT paper in the *Physical Review* by Ives and Kingsbury reports the development of a practical method for photometric comparisons independent of physiological phenomena and based entirely on considerations of energy. The idea is not a new one, but its evolution into a practical method means a large amount of laborious investigation. Especially in comparing lights of different colors does the eye show its incapacity for systematic and accurate judgments. Heterochromatic photometry, in fact, has been the snag upon which the best-meant efforts at precision have struck. The flicker photometer eliminates many of the difficulties of the situation, yet since this type of instrument depends on somewhat intricate physiological phenomena it is not free from objections. The physical photometry here described merely evaluates the energy of the physical radiation produced by the source after transmission through a screen which has a transmission curve equivalent to the sensation curve of the eye. In other words, by such a screen the incident energy is reduced to its visual values and is then measured in the ordinary way with the thermopile. A liquid screen has been very ingeniously devised closely to approximate the peculiarities of the eye in its transformation of energy into sensation. Obviously such a screen must represent, not a single isolated observer, but the average of a large number. An auxiliary water-tank screen is used to hold back the residual infra-red radiation, and between the luminosity screen and this tank are interposed a shutter and a sector disk. The energy received from the illuminant is thus sifted to its true luminosity value and measured by the thermopile connected to a sensitive galvanometer.

Such an apparatus enables a ready comparison to be made between the luminous values of various sources of light, each being obtained in terms of energy recorded by the thermopile, and the results being strictly comparable. The difficulties of the situation are primarily those belonging to thermopile measurements in general. In addition, Ives and Kingsbury adopted a device of using the sector disk so that all the deflections are held to approximately the same amount, which greatly facilitates accurate comparisons. With all proper precautions taken, the experimenters report that they can secure a precision better than 1 per cent in the results. This, of course, assumes that there is no change, either accidental or progressive, in the absorption produced by the tanks. Such a change would cut very little figure in successful comparisons as between one source and another, but it might be serious in an attempt to evaluate the candle-power of a lamp in absolute measure while depending on the constants of the apparatus. A little difference of cleanliness in the bounding surfaces of the tanks might easily introduce an error larger than all the other experimental errors put together.

With proper precautions, however, it looks as if Ives and Kingsbury had devised a very useful photometric method which many a time will prove convenient in attacking the problem of comparing lights varying in color. It is no small achievement merely to have devised a solution corresponding accurately to the sensibility curve of the eye, which, after all, was the real problem to be solved.

The Coming Issues

THE million-volt transformer installed at San Francisco during the closing days of the Exposition—its performance and operation—will be the subject of an illustrated article in the engineering number next week—the third issue of the month. Opportunities for the young electrical engineer in central-station work will be discussed by John F. Gilchrist, vice-president of the Commonwealth Edison Company, Chicago, in the same number. Other articles will treat of tendencies in handling large loads on underground distribution systems, with details of recent practice in the use of sector cable; the construction of an oscillograph for demonstrating voice waves and similar harmonic phenomena before lecture classes, and other topics of engineering interest. In the commercial issue of Feb. 26 a leading article will point out how the central station may utilize the local newspapers to educate the public to a better appreciation of the utilities and their service. Successful sales campaigns in the lighting and appliance fields will be described in detail, and there will be articles of special interest to the electrical dealer and contractor, besides the regular departments. An account of a successful effort to encourage a lighting company's customers to share in its business will be a feature of the first or public-relations issue of March.

Chronicle of Events of the Industry and of Important Movements in the Field

NEWS OF THE WEEK

Reports of Conventions and Meetings of Electrical Associations and Societies

Important Conference on Electric Ranges

A two-day meeting of the electric range committee of the National Electric Light Association was held in Salt Lake City on Feb. 7 and 8. Chairman W. R. Putnam had with him all the members of the committee. In addition there were in attendance representatives of a number of the largest manufacturers of electric ranges. Reports of the sub-committees were read and discussed. Such subjects as rates for service, co-operative advertising, intercourse between central stations and manufacturers, merchandising problems and water-heating developments were brought up. The form of report for presentation to the Chicago convention next May was agreed upon, and there is little doubt that this paper will be one of the most complete, instructive and valuable reports along the line of central-station development ever prepared by an association committee. The data compiled demonstrated that all live operating companies are intensely interested in this very important subject and that the expectations of sales of Pacific Coast and Rocky Mountain States for the year 1916 will reach a total of 10,000 ranges.

Tenney Interests Convene at Boston

The annual convention of the central-station properties managed by Charles H. Tenney & Company, Boston, Mass., was scheduled to be held at the Engineers' Club, Boston, Feb. 11 and 12. The opening session was planned to include seven papers on accounting, the subjects being as follows: "Accounting Organization," by I. S. Hall; "Delegating the Details," by G. W. Hurn; "The Accounting Department and the Customer's Goodwill," by C. N. Alexander; "Handling Stock as Money, or the Storekeeper as a Member of the Accounting Department," by W. H. Phillips; "The Accounting Department and the Public Service Commission," by H. F. Peirce; "Prepayment Meters," by A. G. Neal, and "Garage Costs," by E. A. Harris. The general sessions program included ten papers devoted to gas or electrical topics, among these being the following: "Covering 200 Miles of Territory," by E. C. Peebles; "Making Over an Old Building into a Modern Office Building," by F. L. Ball; "Salem's Recovery," by S. Fred Smith; "The Science of Buying," by G. A. Rust; "Accident Prevention," by C. E. Paige, and "Inspections," by A. E. Bliss. The convention program is to close with the celebration of "Flag Night" at the Copley-Plaza Hotel, when a reception to delegates and ladies will be followed by a dinner and dance, the principal speaker at the former being Levin J. Chase, Concord, N. H., on "The Soul of a Nation."

Federal Trade Commission About to Issue Rulings and Reports

The Federal Trade Commission is about to issue a number of rulings and reports. Among the most important of these will be a series of rulings, based on the results of forty cases which have been investigated, which will define what unfair competition is.

One report which, it is said, will be ready in about a month will give the result of an extensive inquiry into the health of business in the United States. More than 300 lines of business came within the scope of the inquiry. On or about April 15 a report on competitive conditions in foreign trade will be made to Congress. Twenty special agents have gathered the material for this in the United States and abroad.

Another report soon to be made will cover an investigation of laws relating to commerce all over the world. This is principally the work of Chairman Davies and is said to consist in the main of a compilation of statutes.

There are said to be about 200 complaints before the commission. About forty cases have been settled without formal action by the commission.

Water-Power Situation in Washington

A minority of the Senate lands committee has now filed a report protesting against the bill which that committee by a majority vote substituted for the Ferris bill as the latter passed the House of Representatives. There is about to take place in Washington a lining up for and against the various water-power measures, as the Shields bill is on the Senate calendar and is now being debated in the Senate.

Statements have been issued by Gifford Pinchot and by Senator Underwood of Alabama, taking sides for and against the bills. Mr. Pinchot's statement is in the form of an open letter to President Wilson, asking him to aid in defeating the Shields bill and asking him also to aid in defeating the substitute for the Ferris bill reported out by the majority of the Senate committee on public lands. In his statement he draws attention again to the Secretary of Agriculture's recent report to the Senate on water-powers, claiming that there is a monopoly of water-powers in the United States. The Senate committee on printing recommended that the report be published, but the Senate has held up the printing of the report, perhaps only temporarily.

Secretary Garrison has been heard by the House committee on interstate and foreign commerce in regard to the Adamson bill and has drawn attention to the fact that the United States is without a sufficient supply of nitrates from which to manufacture ammunition. If Chile, he said, were to put an embargo on her nitrates, the United States would find itself practically helpless if engaged with a foreign foe, unless the Adamson bill is passed, providing as it does opportunity for the manufacturing of nitrogen from hydroelectric plants.

In his statement Senator Underwood, combating Mr. Pinchot's views, said in part:

"One of Mr. Pinchot's main objections to the Shields bill is based upon the idea that if the bill passes it will enable great corporations to monopolize the water-powers of the country. If it be true that there is a monopoly of the water-powers of the United States to-day, which I do not recognize to be a fact, the failure to pass legislation only makes that monopoly more secure in its actual vested interests because the competition is throttled by the failure to develop the water-powers on the navigable streams of the United States.

"There has been no development of the water-powers on navigable streams under existing legislation in the last decade, and if the obstructionists who have endeavored to prevent legislation that will bring about the development of the water-powers of the navigable streams of the country should succeed in their efforts to block legislation, there would be no relief from the monopoly they complain about.

"The Shields bill does not grant rights or privileges to any one, but merely places in the hands of the Secretary of War, acting through the government engineers, the right to grant permits to build dams for the purpose of aiding navigation and the production of hydroelectric power on such terms as the government in its wisdom shall accept.

"I am not prepared to agree to a statement that implies that our government, acting through the Secretary of War and the engineers of the United States, would consent to permits that would continue or produce a monopoly of the hydroelectric power of this country."

Claims Filed on Oregon Water-Powers

John H. Lewis, State engineer of Oregon, has issued a statement showing that under the State law requiring persons or corporations claiming the right to use water for power purposes to file annually a statement of their claims 219 claims were filed on Jan. 1, 1916, totaling 456,410 hp. This includes water actually being used and that claimed for future use. Claims were filed for water in every county in the State except three, Clatsop, Gilliam and Wheeler.

The number of horsepower claimed in each county follows: Washington, 513; Benton, 186; Umatilla, 8862; Marion, 8237; Wallowa, 1887; Linn, 3127; Douglas, 7927; Harney, 219; Baker, 5685; Clackamas, 349,716; Hood River, 25,737; Wasco, 4413; Morrow, 123; Union, 1529; Polk, 170; Jackson, 14,498; Yamhill, 503; Klamath, 3869; Grant, 4681; Lane, 992; Sherman, 25; Lincoln, 20; Crook, 11,719; Curry, 29; Multnomah, 818; Lake, 236; Josephine, 626; Jefferson, 5000; Tillamook, 133; Coos, 10; Columbia, 11; Malheur, 454.

The principal claimant in Umatilla, Hood River and Wasco Counties was the Pacific Power & Light Company, with plants on the Walla Walla, Hood and White Rivers. The principal claimant in Clackamas County was the Portland Railway, Light & Power Company, with plants on the Sandy, Clackamas and Willamette Rivers, serving the city of Portland. A license of 10 cents each for the first 100,000 hp., 5 cents each for the next 900,000 hp., and 1 cent each for all in excess of 1,000,000 hp. is required. State, federal or city plants, or those of less than 25,000 hp., pay no license fee. The money is used by the State for stream gaging and topographic surveys.

Water-Power Bill Being Debated in the Senate

The Shields bill, otherwise known as the dam-site bill, is now on debate in the Senate as the unfinished business of that body, and is expected to occupy the attention of the Senate for some time. Notwithstanding the fact that this bill is the unfinished business of the Senate and therefore takes precedence, the foreign relations committee has brought in such measures as the Haitian, Nicaraguan and Colombian treaties, and when motions are made to go into executive sessions to consider these treaties behind closed doors the water-power bill is laid aside.

For this reason it is believed that not more than an hour or so each day will be given to debate on the water-power bill.

Preliminary to the taking up of the water-power bill, the Senate voted to have printed what is known as Part I of the report on the development of electrical power recently made by the Secretary of Agriculture. Part I of this document, which charges that there is a monopoly of water-powers in the United States, consists of the text, and Part II consists of the plates, diagrams, etc. In a long debate in the Senate, some of which was aimed at preventing the publication of the report as a public document, it was brought out that the preparation of the material cost about $20,000. It was also stated that the printing of the report as a whole would cost another $20,000. Senators who are favorable to the publication of the report brought out the fact, as attested by documents from many persons, that much of the information therein has never become public before. Much of this material was published in the ELECTRICAL WORLD last week.

The belief continues in Washington, according to the representative of the ELECTRICAL WORLD at the capital, that the whole fate of the so-called conservation bills, so far as water-power matters are concerned, at this session of Congress rests upon the opinion Senators gather from the Secretary of Agriculture's report when they see it. Only a few Senators have seen it in manuscript form. On the House side of the Capitol likewise the appearance of the report is awaited with interest, and many Representatives have declared their intention to "mark time" until Part I is available for examination as a public document, so far as the water-power bills in the House are concerned.

Pole Nuisance Threatened by Municipal Paralleling in Los Angeles

The plan proposed by the city of Los Angeles for paralleling the distributing systems of the Southern California Edison Company, the Pacific Light & Power Corporation and the Los Angeles Gas & Electric Corporation will in effect offset years of the work accomplished by the joint-pole committee, according to a statement by J. E. Macdonald, secretary of the committee, in an address before the Jovian Electric League in Los Angeles on Jan. 19.

For nine years the joint-pole committee has been working to reduce the pole nuisance, Mr. Macdonald said, and it has so co-ordinated the distributing systems that all consumers are served by the use of 70,000 fewer poles than would be required had the companies not initiated the joint-pole movement. In order to carry out the lighting plans now proposed by the city, 45,000 new poles will be required, costing in the aggregate, erected, over $900,000. He stated further that the city could not hope to get more than half the business, and under such conditions could not hope to make sufficient profit to provide for maintenance and depreciation and at the same time take care of its interest and sinking-fund requirements, thus making the pole duplication a useless waste and burden upon the taxpayers.

Present duplication of distribution facilities does not exceed 5 per cent, and this largely represents main feeder lines or construction installed years ago, before the advantages of the co-operative scheme were recognized. The practice now is for each company to develop certain territory fully and not to construct lines in localities already adequately served by another company. The interest, maintenance and depreciation on the poles which the city proposes to erect represent an annual charge of over $150,000, which is part of the price the citizens of Los Angeles will pay for pole duplication alone.

Midwinter A. I. E. E. Convention

Engineers Urged to Assist in Industrial Preparedness—Committee Reorganization Proposed—Commission Regulation, High-Voltage Measurements, and Electric-Railways

IN opening the fourth midwinter convention of the American Institute of Electrical Engineers, held at New York City, Feb. 8 and 9, President J. J. Carty called particular attention to the government's recognition of engineers' advisory ability as evidenced by appointments to the Naval Consulting Board and the recent request of President Wilson to the major engineering societies for support in collecting data to be used in organizing the manufacturing resources of the country in case of emergency. To comply with this request the societies are now selecting representatives in each State who, after being officially appointed by the Secretary of the Navy, will supervise the collection of the data desired. President Carty urged every engineer to assist in this industrial-preparedness campaign.

THE FUTURE OF THE A. I. E. E.

Following the address, D. B. Rushmore pointed out that the A. I. E. E. technical committees may soon be handicapped in meeting the demands of Institute members because of the rapid growth in electrical science and the increase in membership and activities. Several tentative suggestions were offered for improving the organization and procedure of these committees. These provoked considerable discussion.

Several members advocated confining the Institute's activities to electrical science, others favored extending the scope of the Institute to include commercial applications of electricity, still another speaker suggested consolidation of all engineering associations, and one speaker suggested limiting proceedings to general engineering problems. Among those who took part in the discussion were Philip Torchio, E. H. Martindale, Prof. Alexander Gray, Prof. C. F. Scott, W. A. Del Mar, L. T. Robinson, H. G. Stott and Farley Osgood.

MUNICIPALLY OPERATED UTILITIES

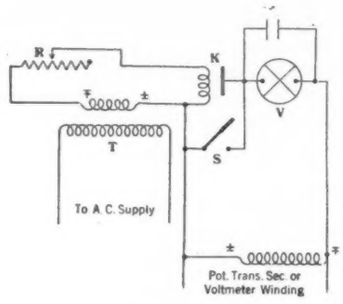
Data on the equipment and operation of numerous municipally operated electrical utilities in western Canada, together with information on the methods of financing these organizations and disbursing the expenses, were presented in a paper by A. G. Christie of Baltimore, Md.

Speakers who were called upon to express their ideas of municipal ownership contended that while many municipally owned organizations issue reports which apparently indicate that they are furnishing service at lower rates than privately owned corporations, it will generally be found that they are not properly disbursing their expenses, providing for obsolesence and depreciation, and carrying their legitimate share of the cities' overhead expenses. Attention was called to the chaotic condition of municipal accounts in New Jersey, and the belief was expressed that municipal as well as privately owned utilities should be regulated by commissions. The discussion was participated in by P. Betts of the New Jersey commission, H. G. Stott, Farley Osgood, R. P. Bolton, E. S. Cheney and others.

SYMPOSIUM ON HIGH-VOLTAGE MEASUREMENTS

At the Tuesday afternoon session the symposium on "High-Voltage Measurements" included four concise papers. These papers were read consecutively and the subject was discussed as a whole. The first paper, by Dr. C. H. Sharp and E. W. Doyle of the Electrical Testing Laboratories, New York City, on "Crest Voltmeters," took up briefly methods advanced by different engineers to measure the crest voltage. The greater part of the paper, however, was devoted to a method devised by the authors whereby crest voltages can be read by an indicating instrument. The apparatus consists of a combination of an electrostatic voltmeter and an electric valve. The electrostatic voltmeter is placed in series with the valve so that the voltmeter becomes charged with the maximum value of the waves. The indications are independent of the frequency of the current and of the shape of the waves except as to its crest value. The pure ionic discharge tube of Langmuir, the "kenotron," is the most available form of valve.

The second paper, also on "Crest Voltmeters," was



METHOD USED BY SHARP AND DOYLE IN MEASURING CREST VOLTAGE

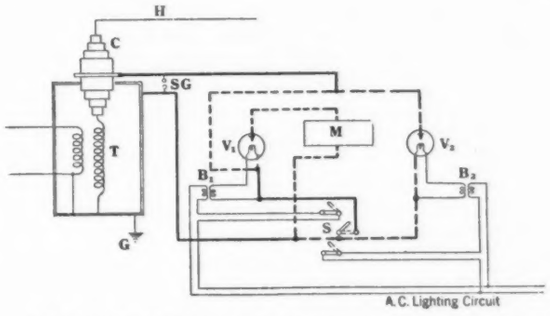
V—voltmeter; *C*—condenser; *K*—electric valve; *B*, *T*—transformer; *S*—switch short-circuiting valve.

presented by L. W. Chubb of the research department of the Westinghouse Electric & Manufacturing Company. This paper took up the construction, operation and applications of a modified type of crest voltmeter. The essential modifications of a form devised by Messrs. Whitehead and Gorton consist of the substitution of a hot-cathode-tube valve for the mercury-arc rectifier. The apparatus as described consists of a testing transformer with a condenser terminal to bring out the high-tension lead, two hot cathode valves, a permanent-magnet indicating instrument, and two bell-ringing transformers for heating the cathode filaments of the valves from a lighting circuit. The condenser terminal takes a charging current proportional to the rate of change of voltage across its terminal. The arrangement of circuits is such that the charging current in one direction passes through the indicating instrument and one valve, while current in the opposite direction passes through the other valve without passing through the meter. The indication is therefore proportional to the crest value of the voltage wave on account of the variation of torque with current in a permanent magnet meter.

The third paper of the session, on "The Voltmeter Coil in Testing Transformers," by A. B. Hendricks, Jr., transformer engineer of the General Electric Company, was a brief discussion of the accuracy of construction in testing work. The last paper, on "Notes on the Measurement of High Voltage," by Prof. William R. Work, Carnegie Institute of Technology, Pittsburgh, Pa., took up experiments to determine the accuracy of methods used in measuring high voltages. Data covering the experiments and records of wave-forms used were discussed to show the range of the meter coil in the high-tension transformer, the crest voltmeter, and derivation of low-tension from primary voltage.

The general conclusions of the papers were as follows: The Sharp-Doyle crest-voltmeter method offers possibilities in the study of surges since the apparatus might be adapted for trapping current or voltage surges to indicate their maximum value. The indications of the

Chubb crest voltmeter are independent of atmospheric conditions and require no corrections except for variations from normal frequency, being correct for all commercial wave-shapes and all distorted waves having not more than one maximum and one minimum value per cycle. The crest voltmeter is the equivalent of the sphere spark-gap but gives a continuous indication instead of the limited indication of the spark-gap. The A. I. E. E. standard spark-gaps should be used as primary standards for calibration only, and a crest voltmeter as a secondary and working standard. It was also concluded by Professor Work in his paper that it is possible to wind, in a high-tension transformer, a voltmeter coil so that the voltage induced when corrected for crest-factor is a satisfactory measure of secondary terminal pressure.



THE CHUBB METHOD OF MEASURING CREST VOLTAGE

T—Testing transformer in grounded case; *C*—condenser terminal to bring out high-tension lead *H*; V_1 and V_2—two rectifiers or valves; *M*—permanent-magnet indicating instrument; *SG*—safety gap; B_1 and B_2—bell-ringing transformers.

In the discussion of the four papers, interesting points were brought out by Prof. E. E. F. Creighton, F. W. Peek, Jr., F. M. Farmer, Prof. Frederick Bedell, Prof. Comfort A. Adams, W. I. Middleton, Prof. J. E. Whitehead, C. L. Dawes and L. T. Robinson.

Professor Creighton of Union College commented on the practical value of the "kenotron" as a valve in crest-voltage measurements, while calling attention to the importance of a study of transient voltages.

Mr. Peek, General Electric Company, reviewed the practical features of three methods of measuring crest voltages, namely, the spark-gap, the crest-voltmeter and the voltmeter-coil methods. He pointed out that while the spark-gap works over a considerable voltage range, at any frequency, with direct current and transient voltages of short durations, it does not read continuously. The crest voltmeter of Mr. Chubb's paper is limited by double-peak waves and requires a high-voltage condenser. He considered the method proposed by Dr. Sharp valuable for laboratory work but limited in practical work by being unable to handle transient voltages satisfactorily. He maintained that with the voltage-coil method, using a transformer of good design, accurate results can be obtained over a wide range of conditions, and that the voltages and waves secured seem to compare closely with those of primary windings.

Mr. Farmer, Electrical Testing Laboratories, New York City, called attention to transformer-ratio difficulties, and showed that while these were overcome by the crest-voltmeter methods, electrostatic-field effects were encountered.

Professor Bedell of Cornell University recalled the work of Professor Duncan and Professor Ryan in measuring crest voltages.

Professor Adams of Harvard University agreed with Mr. Hendricks' paper in reference to the use of the ordinary voltmeter. Professor Adams maintained that the ordinary voltmeter indicates effective values sufficiently accurate for most practical work. He pointed out, however, that any method that does not measure or prevent transients is ineffective.

Professor Whitehead of Johns Hopkins University compared the results of the crest-voltmeter with the accuracy of the oscillograph and showed a variation of only two-tenths of 1 per cent. He reported successful experience with the "kenotron" on voltages up to 7000. Professor Whitehead also outlined investigations with a corona-type voltmeter, showing that its limitations are largely those of observations. He mentioned the use of the telephone transmitter in detecting changes of voltage values while conducting corona experiments.

Professor Dawes of Harvard University described an electrostatic-peak voltmeter which has been developed for 30,000-volt use where small currents are handled.

The discussion was closed by Mr. Chubb and Dr. Sharp. Mr. Chubb pointed out that corona involved no serious errors in the use of the condenser-terminal crest-voltmeter method described by him. He considered the devices in a standard form to be practical and relatively inexpensive, since comparatively large currents are available for measurement and extremely sensitive instruments are not required.

Dr. Sharp emphasized the fact that the method described in his paper is essentially a low-voltage method, and that the use of condenser multipliers, as has been shown by tests, does not involve serious difficulties.

ELECTRIC-RAILWAY TOPICS

Three electric-railway papers were presented at the Wednesday morning session: "Operation of the Norfolk & Western Railway," by F. E. Wynne; "Chattering Wheel Slip in Electric Motive Power," by G. M. Eaton, and "The Liquid Rheostat in Locomotive Service," by A. J. Hall. Among those participating in the discussion were A. H. Armstrong, F. H. Shepard, B. A. Behrend, W. I. Slichter, William Arthur, H. M. Hobart, and R. E. Hellmund. Desirability of constant-speed motors for traction purposes, possibility of securing uniform acceleration with liquid rheostats and some of their operating problems, and results achieved in electrification of steam roads, were points discussed.

The two papers of the last session of the convention were "Method of Determining the Correctness of Polyphase Wattmeter Corrections," by W. B. Kouwenhoven, and "The True Nature of Speech," by John B. Flowers. Among the speakers who discussed this subject were G. A. Sawin, L. W. Chubb, C. A. Adams, W. H. Pratt and L. T. Robinson. Most of the remarks pointed toward other methods than those described by Mr. Kouwenhoven for determining the power measured by different connections and ascertaining whether connections are properly made.

In Mr. Flower's paper it was contended that the recognition of uttered consonant and vowel sounds depends on the association of certain variations in vibration amplitude rather than infrequency of vibration with certain sounds. The experiments as described in this paper seem to indicate that this assumption is true since any particular sound whispered by either a male or a female has definite variations in amplitude. The construction and operation of a device which will convert whispered sounds into readable amplitude patterns were described.

Considerable interest was shown in the subject by noted investigators such as Dr. A. C. Crehore, H. P. Williams, W. Maver, Jr., W. J. Hammer and others. Some questioned whether amplitude of vibration is the distinguishing difference between sounds.

The dinner-dance, which was held at the Hotel Astor on the evening of Feb. 8, far surpassed the same function of previous years as regards attendance, about 420 being present as compared with 300 last year.

Talks in the Industry

Edward W. Rockafellow of the Western Electric Company Sees the Jobber, the Dealer and Contractor as the Ideal Agencies to Develop Household-Appliance Sales

By Frederic Nicholas

Every man in the industry agrees that the successful merchandising of household appliances is a troublesome problem, and that the producers have only begun to reach the possible large markets. There is a difference of opinion as to the best means of distribution of appliances to the public. Jobbers and dealers and contractors are confident that they offer the most satisfactory avenues for sales. But the practice and judgment of central-station officials present conflicting ideas; some believe in the jobber and the dealer and contractor, and others hold that the central-station company serves its own interest most surely when it engages directly in the business.

A perennial issue which is so important as this one has strong advocates on both sides. One of those who is most widely known as an earnest supporter of the jobber and dealer and contractor is Edward W. Rockafellow, assistant general sales manager of the Western Electric Company. For a number of years he has been either selling personally or in charge of others who sell directly. Now he has direct supervision of sales in the various jobbing branches of the Western Electric Company in the United States and is therefore in immediate contact with the conditions which these marketing organizations meet. His interview with the Electrical World *representative presents a new point of view on the important question of development through merchandising.*

GREAT and encouraging as is the past and present development in the sales of socket appliances, I am satisfied that it is being retarded by the inefficient methods of merchandising which are found in many communities," declared Mr. Rockafellow. "The lack of co-operation is a discordant note in the process.

"Taking the country at large, a most conspicuous illustration of the maximum benefits of co-operation between central station and contractor and dealer and jobber is that found in the district served by the Pacific Gas & Electric Company. There the men who are engaged in business as jobbers, dealers or contractors are real supporters of the central-station company.

Better Understanding Will Promote Development

"I am in full sympathy with the desire of each branch of the industry to do the best that it can for itself, but conflict of effort means waste of effort. The development of a better understanding between the different parts of the industry, especially in those localities where friction has arisen, will be a substantial help in the promotion of that permanent upbuilding which we all so greatly desire. As one step in the direction of a better understanding, I am trying to further a proposal among the electrical supply jobbers to ask a number of central-station officials to attend our meetings. This should lead to genuine movements for co-operation in many communities. Unfortunately the jobbers and the dealers and contractors in some of the cities have not been in touch with or even met the principal executives of the central-station companies. In some instances, as I happen to know, it is regrettably true that they are timid about going to the head of the central-station company. That is a condition which, in the interest of the larger future before the industry, ought to be overcome. If one side to an internal issue does not know the point of view of the other side, how can there be co-operation?

Room for Every Good Influence

"I am one of those who believe that there is ample field for useful work for every influence that we have within the industry. The Society for Electrical Development, for instance, has a tremendous opportunity in reaching the public. The Jovian League should weld the different trade interests together. But there is a local situation in each community which requires study in order that adequate measures of co-operation may be worked out.

"As a rough guess I should say that 50 per cent of the central stations engage in the business of merchandising appliances and that the other half do not. Although some companies abandon the practice of direct merchandising every year, others take it up, so that, in my opinion, the proportions have remained about the same for several years. The position of the central station which goes into this business is that it does so in order to educate the public in the use of household appliances. Usually it gets a man from a department store, who may not be informed about electricity, to manage the display and sale of its appliances. Sometimes it employs a man who is familiar with electrical matters but has no knowledge of merchandising principles.

"The result frequently has been that the jobber and the dealer and contractor—both the large operators and the smaller neighborhood men—have become discouraged at the idea that the central station might acquire a monopoly in merchandising, and they have stopped handling household appliances. I know of one territory covering considerable area where household appliances are not carried by a single jobber or dealer or contractor.

Make It Easy for People to Buy

"When there is just one store for the distribution of appliances it means that the public has to go to that store if it desires anything. I believe that it is better to have many distributing centers than to have only one. I believe that if a housewife makes up her mind suddenly that she wants an electric iron it is an advantage that she should be able to buy it just around the corner, even if she has to go to a hardware store. We want to make it easy for people to buy.

"I believe that the lighting companies should advertise the advantages of household electric appliances, using sufficient space and agencies to arouse a live public interest in the new developments. Certainly with this stimulus to trade the jobbers and contractors will be ready to meet the public demands. Here is a large number of men—200 jobbers and 10,000 dealers and contractors—making with their organizations a very much greater number, who are a vital part of the electrical industry. The jobbers are doing considerable advertising, and their use of newspaper space is growing very fast. Whatever they do to expand or build up trade helps the central stations to increase their sales of energy.

Large Developments in the Future

"There is a tremendous field ahead in the sale of socket appliances. I always get very enthusiastic when I think of the prospects. If central-station companies decrease rates for heating and cooking, we shall see a remarkable development in that direction. Until very recently most of the appliances which have been placed on the market were for use in lessening household labor.

But there will be ingenuity and progress in other directions. For instance, there is now a toy range; there never has been anything for a little girl before. A little iron is now in process of development, and this will be another practical toy which will promote education in domestic science. Another possibility is the new 6-in. fan. But we are only on the threshold of the possibilities in many different directions.

"Central stations need the support of every branch of the industry. Each branch needs every other branch in a whole-hearted co-operation that shall give us the benefits of the unparalleled opportunities which the future holds. The jobber, so long as he is creative, is sure to prosper. If he fails to be creative, he will reduce himself to the position of a local retailer of staple articles. He should be one of the strongest constructive forces in the industry."

Condemnation of Land for Overflow Legal

The formation of power companies with the right to condemn land for overflow for the purpose of using the waters of streams to generate electricity is legal, according to a decision of the Supreme Court of Indiana, handed down at Indianapolis on Feb. 10, upholding the decision of the Lawrence Circuit Court in holding the Indiana act of 1907 constitutional. The decision is made in holding that the Lawrence Circuit Court did not err in appointing appraisers for the purpose of appraising the damages to the lands of Edmund J. Miller by the building of a dam by the Southern Indiana Power Company across White River for the purpose of furnishing electricity to the cities of Bloomington and Ooolitic, Ind., as well as to private individuals and factories.

On the appeal, among other objections, it was urged that the law under which the company was organized and sought to condemn the land was unconstitutional because it granted special privileges to the company and because it was taking Miller's property for private and not for public benefit.

The Supreme Court reviews the law and holds that there is no showing that any special privilege is given. The court holds that the uses contemplated by the statute and sought by the company are public ones, and consequently not in violation of the constitution, which inhibits any taking for a private use.

Hearing on Yosemite Power Project

At special hearings on Jan. 26, 27 and 28, at Washington, D. C., Secretary of the Interior Lane heard legal arguments on the application of the Yosemite Power Company for permission to make hydroelectric developments on the Main Tuolumne River, in the Yosemite National Park. This application of the Yosemite company, or that of its predecessors in interest, has been pending in the Department of the Interior for several years. Action by the department has been deferred, owing to objections from irrigation districts further down the river and from the city and county of San Francisco, which also has rights on the river within the park.

The application of the Yosemite Power Company is specifically for the right to erect a dam and maintain a reservoir in the Poopenaut Valley, which lies immediately below the Hetch Hetchy Valley. By special act of Congress, passed Dec. 19, 1913, the city and county of San Francisco obtained the right to construct a dam and flood Hetch Hetchy Valley and impound waters therein for the purpose of making certain hydroelectric developments and supplying the city of San Francisco and the adjoining districts with water for municipal purposes. Under the terms of the grant by Congress, San Francisco is compelled to release certain amounts of water from the Hetch Hetchy Reservoir for the benefit of the Modesto and Turlock irrigation districts, and the city objects to any department of the government granting permits for other corporations or individuals to make developments along the Main Tuolumne River between the Hetch Hetchy dam and a point 12 miles further down stream, known as "Early Intake," where the water in the stream will first be diverted into the aqueduct to be constructed by the city.

The grounds for protest are that regulation of the flow by the city would be interfered with and, moreover, the building of a dam, aqueduct lines and power house by other interests would cause physical conflict with the structures to be erected by the city. The irrigation districts object to the granting of any application to the power company on the ground that they have prior rights to the use of water in the river.

The Yosemite Power Company claims to own water rights prior to rights granted by Congress to the city of San Francisco, and as the act of Congress specifically provided that nothing in the act should "be construed as affecting or intending to affect or in any way to interfere with the laws of the State of California relating to the control, appropriation, use or distribution of water used in irrigation or for municipal or other uses, or any vested rights acquired thereunder, and the Secretary of the Interior, in carrying out the provisions of this act, shall proceed in conformity with the laws of said State," the attorneys for the power company argue that, under the laws of California, pursuant to which the company made its water filings in the Poopenaut Valley, the Secretary of the Interior is in effect compelled to recognize the prior rights of the power company as derived under the state laws and issue a permit for the proposed development. The company's representatives further call attention to Section 3 of the act of Congress, which says that "the rights-of-way hereby granted shall not be effective over any lands upon which homesteads, mining or other existing valid claim or claims shall have been filed or made, and which now in law constitute prior rights to any claim of the grantee, until said grantee shall have purchased such portion or portions of such homestead, mining or other existing valid claims as it may require."

As the Yosemite Power Company early last year continued to urge the granting of its application by the Department of the Interior, the latter employed Henry Floy, consulting engineer of New York City, to go to California, examine the physical conditions on the ground, and report particularly with regard to the engineering questions involved and possible interference in the construction plans proposed by the different parties interested. Mr. Floy twice visited California last year and spent considerable time ascertaining the various engineering features involved, and while there in November he held a public hearing at which the officials, engineers and attorneys of the various parties interested appeared and presented evidence, testimony and argument, particularly along engineering lines. Upon submission of Mr. Floy's report, Secretary Lane appointed Jan. 24, at which time he agreed to hear the legal arguments of the respective parties as to their rights in the case and objections as to why the application of the power company should not be granted. This hearing was continued for three days, and at its conclusion Secretary Lane took the whole matter under advisement for further consideration. It is expected that he will hand down his decision some time during the present month.

Control of Developed Power in the United States

Government Report Shows What Proportion of the Total Power Developed by Municipalities and by Public Service Corporations Is Controlled by a Limited Number of Corporations

LAST week we presented some of the results of an investigation of the water-power situation in the United States made by the Forest Service and submitted to the Senate for action. In connection with that report we give below brief résumés for each state taken from the report and purporting to show the extent to which the movement toward concentration of control has progressed.

Alabama.—One company, the Alabama Traction, Light & Power Company, has 87.9 per cent of the developed water-power and 57.1 per cent of the total power of the State. Eight corporations control 90.1 per cent of the total power, and three of these 98.8 per cent of the water-power. Thirty-four municipalities have but 0.8 per cent of the water-power and 4.7 per cent of the total power.

Arizona.—Five companies control 47.4 per cent of the total power. Only one of these, the Arizona Power Company, has developed any water-power. It has 26.8 per cent of the total for the State. The greater part of developed water-power is owned by the United States Reclamation Service, which, together with two municipalities, has 72.1 per cent of the water-power and 27.6 per cent of the total power.

Arkansas.—Water-power affords but little over 4 per cent of the total power. So far as data of developed water-power could be secured, the total appears to be owned by two companies. Eleven companies control 73.5 per cent of the total power from all sources. The seventeen municipal power stations have no water-power and but 9.9 per cent of the total power in the State.

California.—Fifteen corporations control 88.6 per cent of the total primary power in the State, and twelve control 87.8 per cent of all the developed water-power. Of these, the largest is the Pacific Gas & Electric Company, with 20.1 per cent of the water-power, or 152,080 hp., and 25.5 per cent of the total power, or 260.620 hp. Four corporations, the Pacific Gas & Electric Company, the Pacific Light & Power Corporation, the Southern California Edison Company and the Western Power Company, together control more than half of both the water-power and the total power in the State. Municipal developments comprise 6.3 per cent of the water-power and 4.5 per cent of the total power.

Colorado.—Eight corporations control 73 per cent of the total power, and five of these control 77 per cent of the water-power. The largest is the Colorado Power Company, with 45.2 per cent of the water-power and 24 per cent of the total power. This company, together with the Doherty Operating Company, the Utah Securities Corporation and H. M. Byllesby & Company, controls 68 per cent of the water-power and 54.4 per cent of the total power. Ten municipalities own only 1.1 per cent of the water-power and 1.9 per cent of the total power.

Connecticut.—Eight corporations control 92.7 per cent of the developed water-power. Of these, one concern, Stone & Webster, controls 38.2 per cent. Four companies, the New York, New Haven & Hartford Railroad Company, the United Illuminating Company, the Hartford Electric Light Company and Stone & Webster, control 63 per cent of the water-power in the State. These four, together with eleven others, control 87.1 per cent of the total power. The six municipal plants have no water-power and but 5.6 per cent of the total power.

Delaware.—The National Properties Company controls 81.8 per cent of the total electric power installations for which data have been secured. Six municipalities have 8.5 per cent. Water-power development is negligible.

Florida.—Two concerns, Stone & Webster and the Florida Power Company, control 99.6 per cent of the developed water-power and 32.7 per cent of the total power. Eight companies control 58.6 of the total power. Seventeen municipalities control 26.6 per cent of the total power but have no water-power.

Georgia.—Four companies, the Georgia Railway & Power Company, Stone & Webster, the Georgia Light, Power & Railways Company and J. G. White & Company, Inc., control 84.4 per cent of the developed water-power and 73.8 per cent of the total power. Twelve companies control 88.1 per cent of the total power, and ten of these control 93.7 per cent of the water-power. Seventy-five municipalities own but 0.7 per cent of the water-power and 5.2 per cent of the total power. Of the total power for the State, 5.8 per cent is used in manufacturing.

Idaho.—The Utah Securities Corporation controls 48.3 per cent of the developed water-power and 45.5 per cent of the total power. This company, together with the National Securities Corporation, controls 70.8 per cent of the water-power and 67.9 per cent of the total power in the State. The United States Reclamation Service and four municipalities control 9.4 per cent of the water-power and 8.8 per cent of the total power.

Illinois.—Only 29.1 per cent of the developed water-power is controlled by the major corporations. Of the total power, however, 89.2 per cent is controlled by thirteen public-service corporations, one of which, the Commonwealth Edison Company, controls 55.6 per cent of the total developed power. Eighty-six municipalities, including the Chicago Sanitary District, have 63.4 per cent of the developed water-power and 6 per cent of the total power.

Indiana.—This State has a relatively small water-power development. Of such development as has been made, 70.5 per cent is controlled by the Middle West Utilities Company and the Indiana & Michigan Electric Company, the former with 54.4 per cent, the latter with 16.1 per cent. Thirteen corporations control 75 per cent of the total power, while seventy municipalities have but 2.5 per cent of the water-power and 9 per cent of the total power.

Iowa.—Stone & Webster control 94.1 per cent of the total developed water-power, equivalent to 47.4 per cent of the total power in the State. Thirteen corporations together control 80.7 per cent of the total power, and five of these 96.1 per cent of the water-power. Seventy municipalities have 0.4 per cent of the water-power and 5.3 per cent of the total power.

Kansas.—The Doherty Operating Company controls 59.9 per cent of the developed water-power. This company, with two others, controls 81.4 per cent of the water-power. Seven concerns control 46.7 per cent of the total power in the State. Ninety municipal stations have 1.1 per cent of the water-power and 24 per cent of the total power.

Kentucky.—As far as data are available, there is no

water-power development in this State by central stations or electric railways. Two companies, the Louisville Traction Company and H. M. Byllesby & Company, control 60.6 per cent of the total developed steam-power. Eleven companies control 84.7 per cent of the total power, and eighteen municipalities 6 per cent.

Louisiana.—This State has no water-power development of consequence. One concern, the United Gas & Electric Corporation of Connecticut, controls 73.4 per cent of the total developed power from all sources. Six companies control 85.1 per cent. Twenty-five municipalities have 8.9 per cent of the total for the State.

Maine.—Over 58 per cent, chiefly water-power, of the total power shown for the State of Maine is used in manufacturing. Of the total thus shown, the largest percentages are controlled by the E. W. Clark Management Corporation, with 13.4 per cent of the water-power and 16.4 per cent of the total power, and the International Paper Company, with 16.5 per cent of the water-power and 15.9 per cent of the total power. Sixteen concerns control 91.1 per cent of the water-power and 91 per cent of the total power. Five municipalities have only 0.7 per cent of the water-power and 0.8 per cent of the total power.

Maryland and District of Columbia.—Water-power developments are of little importance, affording but 1.5 per cent of the total developed power. Nine companies control 94.9 per cent of the total power, and three of these, the United Railways & Electric Company of Baltimore, the Consolidated Electric Light & Power Company of Baltimore and the Washington Railway & Electric Company, control 78.8 per cent of the total developed power. Seven municipal stations in Maryland have but 1.1 per cent of the total power developed in the State and District of Columbia combined.

Massachusetts.—Nineteen corporations control 83.5 per cent of the total power in the State, and eight of thes control 77.8 per cent of the water-power. Two companies, the New England Power Company of Maine and the Turners Falls Power & Electric Company, control 56.2 per cent of the developed water-power. Thirty-three municipal stations have 0.8 per cent of the water-power and 4.2 per cent of the total power.

Michigan.—Eighteen corporations control 79.5 per cent of the total developed power, and fifteen of these control 76.2 per cent of the developed water-power. Two concerns, the North American Company and the Commonwealth Power, Railway & Light Company, control 53 per cent of the total power, and two, the Commonwealth Power, Railway & Light Company and the Union Carbide Company, control 47.6 per cent of the water-power. One hundred and four municipalities own 5.1 per cent of the developed water-power and 8.8 per cent of the total power. Of the total power for the State as given in the summary tables, 4.2 per cent is used in manufacturing. Were it not for this inclusion, the percentage of control by certain companies of strictly public-service power would be somewhat greater than the above figures indicate.

Minnesota.—Twelve companies control 89.9 per cent of the water-power and 82.2 per cent of the total power. Four of these control 71.9 per cent of the water-power and 65.4 per cent of the total power. One hundred and fifteen municipalities have only one-half of 1 per cent of the water-power and 5.7 per cent of the total power.

Mississippi.—So far as data are available, Mississippi has no water-power developed by public-service corporations. In the total power there is no marked concentration, the largest amount controlled by one concern, the Gulfport & Mississippi Coast Traction Company, being 14.1 per cent. Forty-two municipal stations have 25 per cent of the total power of the State.

Missouri.—Nine corporations control 86.3 per cent of the total power, and one, the Doherty Operating Company, controls 98.7 per cent of the water-power. Three companies, the North American Company, the Doherty Operating Company and the Kansas City Railway & Light Company, control 78 per cent of the total power in the State. Six per cent of the total is developed in municipal stations.

Montana.—Four corporations control 97.4 per cent of the water-power and 91.8 per cent of the total power. Two of these, the Montana Power Company and the Amalgamated Copper Company, affiliated concerns, control 94.4 per cent of the water-power and 88.7 per cent of the total power. Municipal plants have no water-power and but four-tenths of 1 per cent of the total power.

Nebraska.—Only 23.6 per cent of the developed water-power is controlled by the major electric-power corporations. The most important of these corporations are the Omaha Electric Light & Power Company and the Omaha & Council Bluffs Street Railway Company. These two companies control 48 per cent of the public-service power in the State but have no water-power. The seventy-three municipal stations have 46.8 per cent of the developed water-power and 19.7 per cent of the total power.

Nevada.—One concern, Stone & Webster, controls 73.6 per cent of the water-power. This company, together with the Utah Copper Company, controls 74.1 per cent of the total power in the State, while 18.7 per cent of the water-power is owned by the United States Reclamation Service. There are no municipal developments, although one town purchases and distributes power.

New Hampshire.—Three manufacturing concerns, the Berlin Mills Company, the Amoskeag Manufacturing Company and the International Paper Company, have 64 per cent of the developed water-power and 48 per cent of the total power. Fourteen companies, both manufacturing and public service, control 88.1 per cent of the water-power and 85.9 per cent of the total power. Two municipalities have 0.6 per cent of the water-power and 0.8 per cent of the total power.

New Jersey.—Less than 3 per cent of the total power in the State is water-power. Of this amount, 87.5 per cent is controlled by two companies, the New Jersey General Security Company and W. S. Barstow & Company. Of the total power, 68.6 per cent is controlled by one concern, the Public Service Corporation of New Jersey. Nine other concerns together control 17.2 per cent of the total power. Ten municipalities have 1.1 per cent of the water-power and 0.9 per cent of the total power.

New Mexico.—Water-powers afford less than 4 per cent of the total developed power. Of the total power, the Federal Light & Traction Company controls 37.1 per cent. Eight companies together have 66.9 per cent of the total. The United States Reclamation Service and certain municipalities, with four stations, have 22.9 per cent of the total developed power.

New York.—Twenty corporations control 81.4 per cent of the total developed power, and fourteen of these control 74.3 per cent of the developed water-power. Five companies control over one-half of the total power, and two control over one-third of the water-power. Forty-eight municipalities have 0.4 per cent of the water-power and 0.6 per cent of the total power. Of the totals for the State, nearly 12 per cent is power used in manufacturing. If this were omitted from the totals, the percentage of total public-service power controlled by the five largest corporations would be nearly 60 per cent, and of public service water-power by the two largest water-power companies, 45 per cent.

North Carolina.—Two companies, the Southern Power Company and the Carolina Power & Light Company, control 75.1 per cent of the developed water-power and

66.5 per cent of the total power. Eight corporations control 94 per cent of the water-power, and fourteen 89.1 per cent of the total power. Forty-nine municipalities have 1 per cent of the water-power and 5.5 per cent of the total power. Since the totals for the State contain a certain amount of power used in manufactures, the percentages of strictly public-service power controlled by the corporations is greater than the figures indicate.

North Dakota.—Water-power development in this State is negligible. One concern, H. M. Byllesby & Company, controls 36.7 per cent of the total electric power in three stations, as compared with 22.3 per cent controlled by the United States Reclamation Service and certain municipalities in twelve stations.

Ohio.—Ohio shows no marked concentration of electric-power development, although twenty concerns control 77.8 per cent of the total in the State, and seven of these have 67.1 per cent of the total developed water-power. One hundred and fourteen municipalities own 0.9 per cent of the water-power and 7.5 per cent of the total power.

Oklahoma.—Nine companies control 61.9 per cent of the total power. Water-power development in the State amounts to but little over 2 per cent of the total. Sixty-one municipalities have 20.4 per cent of the water-power and 16.7 per cent of the total power.

Oregon.—The E. W. Clark & Co. Management Corporation and the Crown-Willamette Paper Company control 67.7 per cent of the water-power and 65.7 per cent of the total power in the State. Seven companies control 86.4 per cent of the water-power and 82.5 per cent of the total power. Municipal plants contain 3 per cent of the water-power and 2.2 per cent of the total power.

Pennsylvania.—Fifteen corporations control 73 per cent of the total public-service power in the State, and six of these control 88.2 per cent of the water-power. One concern, the Pennsylvania Water & Power Company, controls 70 per cent of the developed water-power. Forty-one municipalities have 0.3 per cent of the water-power and 1.6 per cent of the total power of the State.

Rhode Island.—As far as information is available, Stone & Webster control the entire amount of developed water-power used in public-service operations. Four companies, the New York, New Haven & Hartford Railroad Company, the Narragansett Electric Lighting Company, the Massachusetts Lighting Companies and Stone & Webster, control 98.3 per cent of the total public-service power in the State. There appear to be no municipal developments.

South Carolina.—One concern, the Southern Power Company, controls 56.3 per cent of the developed water-power and 50 per cent of the total power. Twelve companies control 96.4 per cent of the water-power and thirteen 92.3 per cent of the total power. The twenty-one municipal plants have no water-power and but 1.7 per cent of the total power. Of the power included in the totals, 9.6 per cent is used in manufacturing.

South Dakota.—The Homestake Mining Company has 47.8 per cent of the total water-power in the State. Three other companies control 43.1 per cent, making a total of 90.9 per cent for the four. The seventeen municipal stations have no water-power and but 5 per cent of the total power.

Tennessee.—Two corporations, the E. W. Clark Company Management Corporation and the Chattanooga & Tennessee River Power Company, control 88.9 per cent of the developed water-power and 62.5 per cent of the total power. Five companies control 98.3 per cent of the water-power, and nine companies 92.9 per cent of the total power. Twenty-nine municipal plants contain but one-third of 1 per cent of the water-power and but 3.7 per cent of the total power.

Texas.—Three companies control 68.5 per cent of the water-power, and two companies, Stone & Webster and the American Power & Light Company, control 53 per cent of the total power. Thirteen companies control 77 per cent of the total power. Twenty-one municipalities have 3.3 per cent of the water-power and 3.8 per cent of the total power.

Utah.—One concern, the Utah Securities Corporation, controls 82.2 per cent of the developed water-power and 84.3 per cent of the total power. Twenty-two municipalities have 7.4 per cent of the water-power and 6 per cent of the total power.

Vermont.—Two public-service companies, the New England Power Company of Maine and the American Gas Company, and one manufacturing concern, the International Paper Company, control 51.6 per cent of the total developed water-power and 44.4 per cent of the total power. Fifteen companies control 90.7 per cent of the water-power and 89.2 per cent of the total power. Thirteen municipalities have 4.2 per cent of the water-power and 4.6 per cent of the total power. As noted for several other States, power used in manufacturing to the extent of 20 per cent of the total has been included. Were it not for this inclusion the percentages of control of public-service power by certain corporations would be considerably greater than would be indicated by the above percentages.

Virginia.—Two public-service corporations, the Virginia Railway & Power Company and H. M. Byllesby & Company, and one manufacturing concern, the Riverside & Dan River Cotton Mills, control 56.4 per cent of the developed water-power and 56.9 per cent of the total power. Fourteen companies control 85.3 per cent of the total power, and nine of these control 80.5 per cent of the water-power. Fifteen municipal stations control 6.5 per cent of the water-power and 6 per cent of the total power.

Washington.—Two concerns, Stone & Webster and the Washington Water Power Company, control 53.8 per cent of the water-power and 54.7 per cent of the total power. Ten corporations control 78.6 per cent of the water-power, and twelve 77.5 per cent of the total power. Washington has a considerable municipal development, twelve cities and towns owning 16.5 per cent of the water-power and 16 per cent of the total power in the State.

West Virginia.—Five companies control 97.3 per cent of the developed water-power, and one concern, the Union Carbide Company, 49.4 per cent. Fifteen companies control 85.1 per cent of the total power. Six municipalities have 1.3 per cent of the total power but no water-power.

Wisconsin.—Of the developed water-power, 74.6 per cent is distributed among eighteen corporations. The largest percentages in control of single corporations are 11.5 per cent by H. M. Byllesby & Company and 10.7 per cent by the Wisconsin River Power Company. Similarly, 71.2 per cent of the total developed power of the State is distributed among nineteen corporations, the North American Company having the largest individual percentage—25.5 per cent. Eighty-five municipalities have 1.4 per cent of the water-power and 4.1 per cent of the total power. The totals for this State contain a considerable amount—19 per cent of the total—of power used in manufacture.

Wyoming.—Water-power development is of minor importance in Wyoming, the total amounting to only 2544 hp. The total electric power installation from all sources is less than 18,000 hp. Two corporations control 44.2 per cent of this, and nine 77.7 per cent. The United States Army and municipal stations utilize 34 per cent of the water-power in Wyoming and 7.1 per cent of the total power.

Changes in Steam Station of Rhode Island Company

Additions to One of the Largest Street-Railway Generating Stations of New England—Units Installed Can Carry Entire Rhode Island Trolley Load

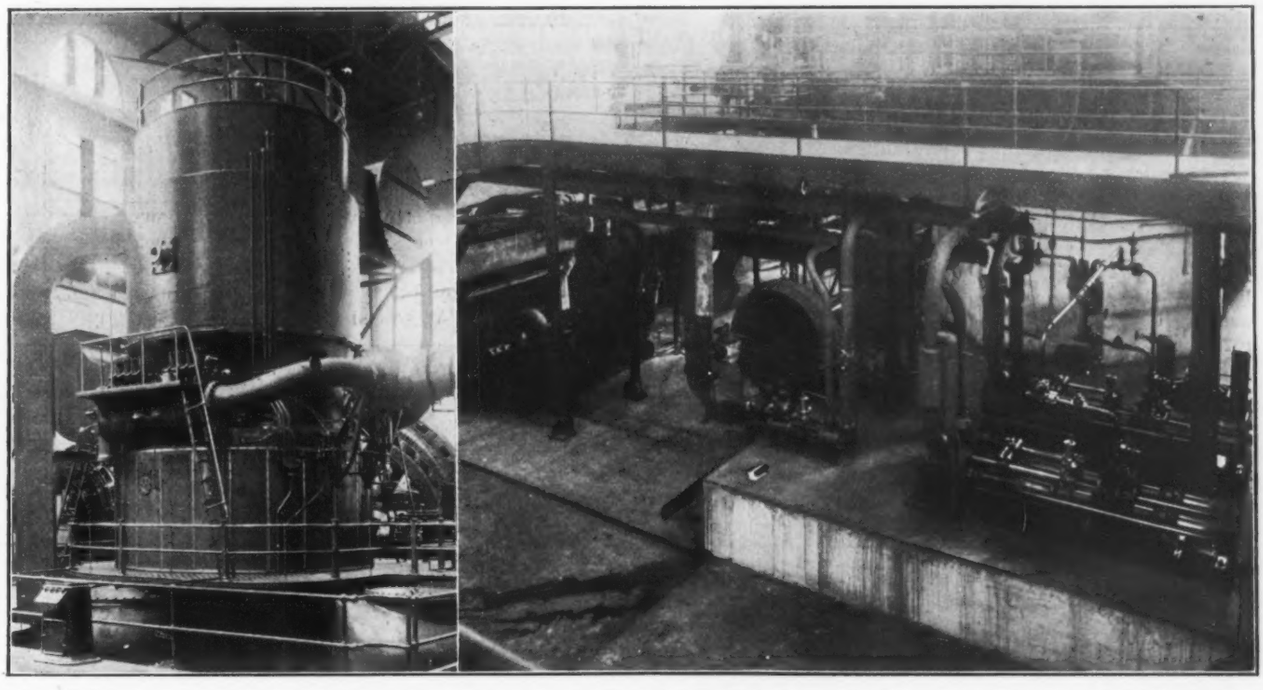
THE supply of electrical energy for the operation of street railways in the greater part of the State of Rhode Island is furnished from the Manchester Street generating station of the Rhode Island Company at Providence. This station is situated on tidewater and supplies both direct current and alternating current to the outgoing lines of the company's distribution system. The plant has a rating of 40,500 kw. and is the second largest in the New England States devoted to street-railway service. When built in 1904, the design provided for a double-deck boiler house, with generators directly connected to both vertical and horizontal reciprocating engines equipped with jet condensers. Increasing demands for power resulting from the extension of the company's service led to the installation about two years ago of a 15,000-kw. turbo-alternator to take the place of a 1600-kw. vertical engine-driven unit. A second unit of 15,000-kw. rating was installed in 1914. The changes in connection with the installation of these units have called for an extension of the boiler house and engine room as shown in the illustrations.

The present generating equipment is housed in a brick and steel structure, with concrete foundations. The original boiler equipment consisted of sixteen 520-hp. Babcock & Wilcox boilers mounted eight on each boiler-house deck. These units discharged their products of combustion through Green fuel economizers into a brick stack 312 ft. high and 16 ft. in inside diameter. The new boiler installation consists of eight 625-hp. Bigelow-Hornsby boilers, also arranged in two decks, and delivers gases into a breeching leading to a chimney 200 ft. high and 21 ft. in inside diameter. In the operation of the present station the old boilers are held in reserve, the load being carried mainly on the turbo-driven generators. The boiler equipment is operated at 200 lb. per square inch pressure with 125 deg. Fahr. superheat. The eight new Bigelow-Hornsby boilers have carried the entire station peak at its maximum of 23,000 kw., and one of the 15,000-kw. turbo-generators has been found sufficient to carry virtually all the cars operated within the State except on the service peak. The yearly output of the station was 66,731,200 kw.-hr. in 1915.

PRIME MOVERS AND GENERATORS

The two large 15,000-kw. turbines are each of the General Electric vertical type and deliver energy at 11,000 volts, three-phase, twenty-five cycles. The other generating equipment units consist of two 1500-kw. horizontal engine-driven General Electric generators, one 2500-kw. horizontal Westinghouse turbo-generator, and two 2500-kw., 600-volt direct-current generators driven by vertical engines. All the reciprocating engines are the cross-compound condensing type and are held in reserve, except that one direct-current generator is used over peaks frequently in the winter time to help the rotaries. Minimum loads have been carried on the horizontal turbo-generator. Five rotary converters, aggregating 9000 kw. in rating, are installed to supply direct current to local trolley service, the usual transformer banks being provided between the alternating-current buses and the rotaries.

In both the boiler installations the boilers are arranged on one side of a firing aisle, which simplifies the steam piping and narrows the width of the building. The supply of air to the Taylor stokers used under the Bigelow-Hornsby boilers is furnished by two Sirocco fans, each having a rating of 250,000 cu. ft. of air per minute and gear-connected in each case to a 600-hp. steam turbine. The gear ratio is 1 to 7.35, the fans operating at a speed of 460 r.p.m. under full rating



FIGS. 1 AND 2—A 15,000-KW. TURBO-GENERATOR, WITH CONDENSERS AND PUMPS BELOW, IN MANCHESTER STREET STATION OF RHODE ISLAND COMPANY

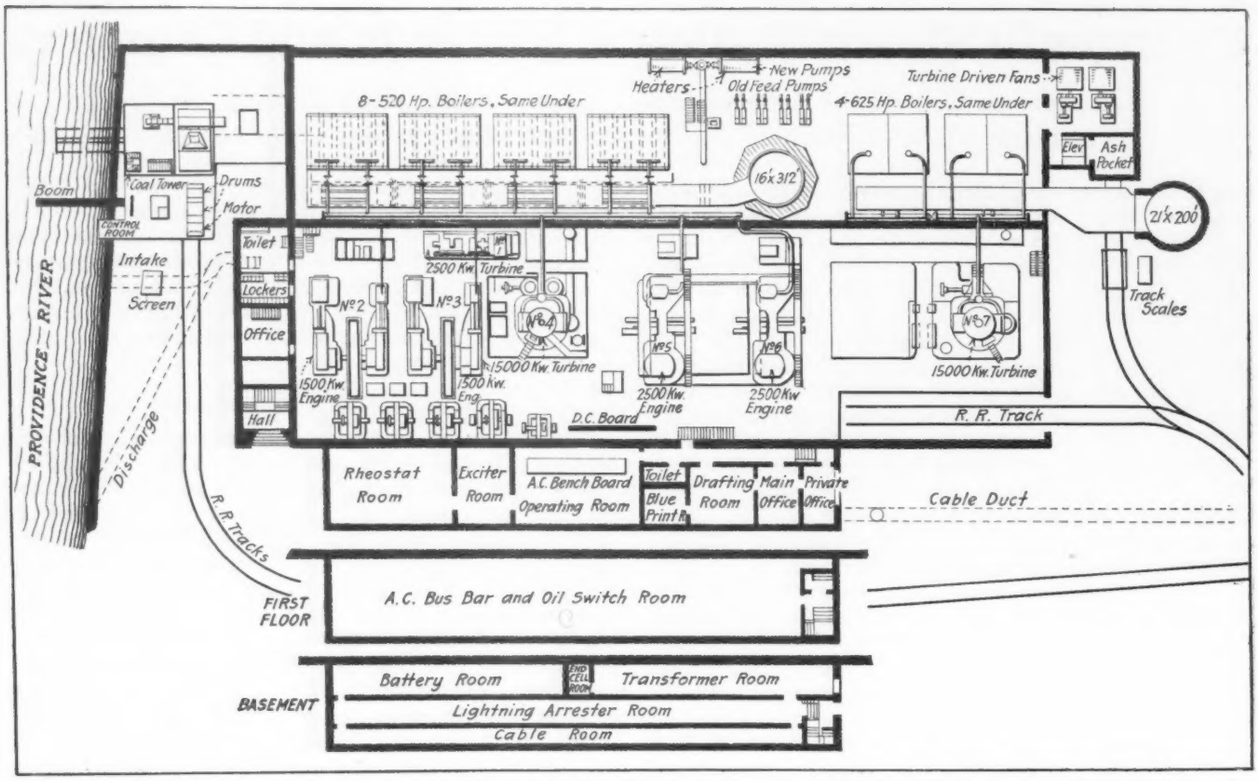


FIG. 3—PLAN OF MANCHESTER STREET STATION, SHOWING ARRANGEMENT OF STEAM AND ELECTRICAL EQUIPMENT

and delivering air against a pressure of 5.5 in. of water at the fan outlet. The fan turbines operate on 200 lb. per square inch steam pressure and 125 deg. Fahr. superheat, with 16.7 lb. per square inch absolute back pressure. The guaranteed steam consumption under these conditions was not more than 25 lb. per brake-horsepower, including the gear losses. The turbine speed is controlled automatically by a Mason regulator.

The boiler-feed water is taken from the city mains through two 10-in. independent lines. The feed water is measured by two Simplex V-notch meters, and at the present time no water treatment is required. Two Platt turbo-feed pumps are installed and four horizontal duplex Worthington feed pumps held for reserve use. Two National open-feed water heaters of 5000-hp. rating each are also installed.

Each of the 15,000-kw. turbines exhausts into a Westinghouse-Le Blanc condenser in the basement under one side of the turbine's foundation. The condensers are designed to maintain a vacuum of 28 in. absolute when condensing 250,000 lb. of steam per hour with injection water at a temperature not exceeding 70 deg. Fahr., the temperature of the discharge being not less than 5 deg. Fahr. below that corresponding to the vacuum. At full load one unit requires 8,000,000 lb. of injection water per hour. Salt water drawn from the river under a head of 20 ft. through a concrete conduit is used for circulating purposes and discharged into a suction well, from which a 36-in. pipe carries it into a manifold on the basement floor. From here two 20-in. main injection pipes lead to each condenser.

COAL AND ASH HANDLING EQUIPMENT

Coal is received at the plant from barges in the Providence River and elevated in a 1-ton bucket to a pocket in a hoisting tower. From here it is discharged through a crusher, falling into a chain-driven bucket conveyor. From the conveyor it is discharged into either coal bunker, all being on the same level. The hoisting bucket is handled by a 25-hp. motor and the conveyor is driven by a 50-hp. motor. From the bunkers cast-iron chutes deliver the fuel to a stoker hopper in front of the furnaces. The old boilers are equipped with Roney stokers and the new units with Taylor stokers.

Ashes are discharged from below the grates into hopper-bottom cars, which are pushed by hand on narrow-gage tracks to an electric elevator at one end of the building and then delivered to a receiving hopper discharging into cars out of doors at the rear of the new chimney, as shown in the plan of the station. Provision is made for the open-air storage of about 10,000 tons of coal in the station yard. About 200 tons of coal is burned per day, the standard fuel being Pocahontas run-of-mine with a heat value of over 14,750 B.t.u. per pound.

FIG. 4—FEEDER CONNECTIONS TO OVERHEAD LINES IN BASEMENT OF STATION

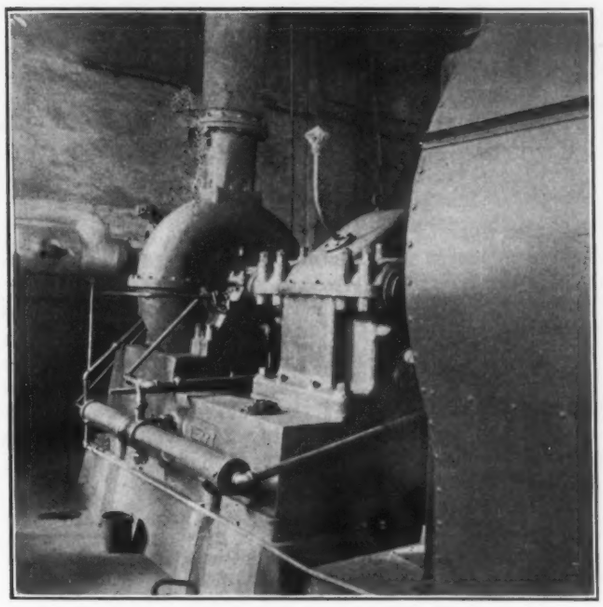


FIG. 5—A 600-HP. TURBINE DRIVING MECHANICAL DRAFT FAN RATED AT 250,000 CU. FT. OF AIR PER MINUTE

GENERATING STATION CIRCUITS

Each of the 15,000-kw. turbine units delivers three-phase, twenty-five-cycle current at 11,000 volts to the station buses, one unit ordinarily being operated about twenty-four hours daily. The generator leads are run from the machine in a 12-in. by 14-in. sheet-iron casing leading to the basement. For each generator circuit 4 per cent reactance is installed in a fireproof chamber at the basement level, and from the reactors the leads are carried to a bus and oil-switch room situated in a fireproof extension at one side of the station building.

The electrical circuits of the station include two sets of three-phase, 11,000-volt buses with motor-operated General Electric oil switches arranged to connect any alternator with either set of buses and any feeder or any local transformer circuits with either set. The

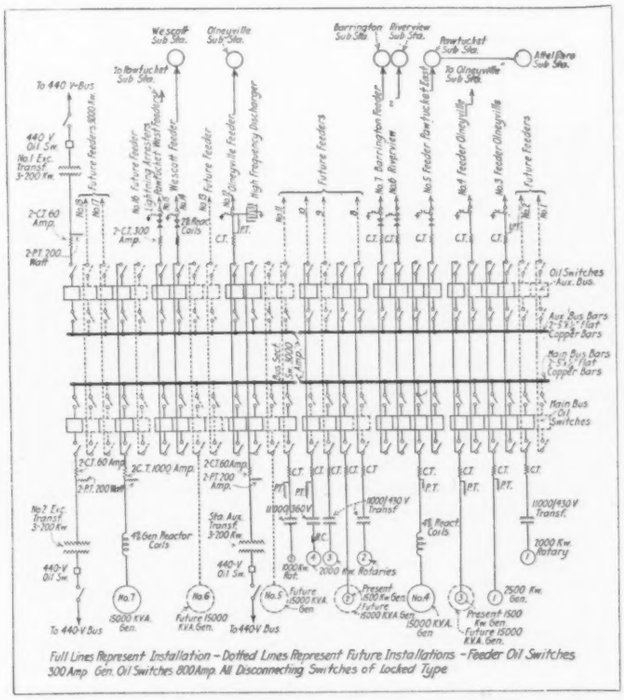

Wescott Sub Sta.
Olneyville Sub Sta.
Barrington Sub Sta.
Riverview Sub Sta.
Pawtuxet Sub Sta.
Athol Dare Sub Sta.
To 440 V Bus
To Pawtuxet Sub Sta.
To Olneyville Sub Sta.
440 V Oil Sw.
No.1 Exc. Transf. 3-200 Kw.
2-CT. 60 Amp.
2-PT. 200 Watt
2-CT. 300 Amp.
Future Feeders 6000 Kw.
No.10 Future Feeder
Lightning Arresters
No.9 Pawtuxet West Feeder
No.8 Wescott Feeder
No.7 Future Feeder
No.6 Olneyville Feeder
High Frequency Discharger
Future Feeders
No.1 Barrington Feeder
No.2 Riverview
No.3 Feeder Pawtuxet East
No.4 Feeder Olneyville
No.5 Feeder Olneyville
Future Feeders
Oil Switches Aux. Bus.
Aux. Bus Bars 2-5/8" x 1/4" Flat Copper Bars
Main Bus Bars 2-5/8" x 1/4" Flat Copper Bars
Main Bus Oil Switches
3C.T. 1000 Amp.
2-PT. 200 Amp.
No.7 Exc. Transf. 3-200 Kw.
4% Gen. Reactor Coils
5th Aux. Transf. 3-200 Kw.
440-V Oil Sw.
11000/360 V
11000/440 V Transf.
4% Reactor Coils
3000 Kw. Rotary
2000 Kw. Rotaries
No.7
No.6
No.5 Future 15000 KVA. Gen.
No.4
Present 1500 Kw. Gen. Future 5000 KVA. Gen.
Present 1500 Kw. Gen. Future 15000 KVA. Gen.
7500 Kw. Gen.
15000 KVA. Gen.
Future 15000 KVA. Gen.
To 440-V Bus
To 440 V Bus
Full Lines Represent Installation – Dotted Lines Represent Future Installations – Feeder Oil Switches 300 Amp. Gen. Oil Switches 800 Amp. All Disconnecting Switches of Locked Type

FIG. 6—STATION CIRCUITS AND OUTGOING FEEDERS

installation is controlled from a benchboard in the gallery overlooking the operating room.

Each generator is provided with a reverse energy relay in two phases, controlling the oil switch in the generator lead. The benchboard has a temperature-indicating set with connections to each generator armature. The auxiliary station service is controlled at the nineteen-panel switchboard on the gallery floor. Two sets of station three-phase auxiliary buses are installed, one at 220 volts for motor starting and the other at 440 volts for normal operation. The buses are run at the rear of the auxiliary board with a horizontal sectionalizing switch for breaking up the services in emergency. Three sets of station power transformers are mounted in basement compartments with adjacent remote-controlled solenoid-operated oil switches in the tops from the transformer secondaries to the 440-volt and 220-volt auxiliary buses. The station lighting is at 125 volts, arrangements being provided for both direct-current and alternating-current supply.

W. C. Slade is superintendent of power and lines of the Rhode Island Company, D. F. Miner is chief engineer of the Manchester Street station, and F. L. Barnard is chief electrician.

TABLE OF STATION EQUIPMENT.

PRIME MOVERS AND GENERATORS.

Two 15,000-kw. General Electric turbo-generators, operating at 11,000 volts, three-phase, twenty-five cycles, with a steam pressure of 200 lb. and 125 deg. Fahr. superheat, are installed.

Two Westinghouse-LeBlanc condensers maintain a vacuum of 28 in. for the 15,000-kw. units, when condensing 250,000 lb. of steam per hour, with injection water at 70 deg. Fahr.

One 2500-kw. horizontal Westinghouse turbo-alternator operates under the same conditions as the large units.

Two 1500-kw., 11,000-volt General Electric generators are driven by Filer & Stowell horizontal cross-compound engines operating on 150 lb. steam pressure.

Two 2500-kw. generators, one Westinghouse and one General Electric, are driven by Westinghouse vertical cross-compound engines operating at 150 lb. steam pressure. The engines exhaust into Blake twin vertical condensers, and the 2500-kw. turbine into an Alberger jet condenser.

Five rotary converters, aggregating 9000-kw., supply direct current to the local trolley circuit.

BOILER-ROOM EQUIPMENT

Sixteen 520-hp. Babcock & Wilcox boilers are installed in double-deck arrangement to generate steam at 150 lb. and 130 deg. Fahr. superheat, but operated at about 80 deg. Fahr. superheat by running some of the boilers to give saturated steam, and mixing. Boilers are equipped with Roney stokers and Green fuel economizers.

Eight 625-hp. Bigelow-Hornsby boilers with Taylor stokers are installed in the new addition and serve the 15,000-kw. turbine units. Each of these boilers has a General Electric steam-flow meter.

Two Sirocco fans, rated at 250,000 cu. ft. per minute each, are geared to Terry steam turbines, and supply air at 5.5-in. pressure for Taylor stokers. Falk herringbone gears are used with a speed reduction of 7.35. The turbines operate at 3370 r.p.m., with speed automatically controlled by a Mason regulator.

Two Platt turbo feed pumps, rated at 1500 gal. per minute, serve the boiler equipment, with four horizontal duplex Worthington feed-water pumps held in reserve. Feed water is measured by two Simplex V-notch meters.

Two National open-feed water heaters of 5000-hp. rating each are used.

SWITCHBOARD EQUIPMENT

A General Electric benchboard of fourteen sections accommodates eighteen 11,000-volt feeders. Seven generator panels, six feeder panels and one station panel are provided.

A switchboard for auxiliary station service contains nineteen panels with the necessary equipment.

The bus room provides for fifty-four General Electric type H6 motor-operated oil switches, which connect generators and feeders to buses.

MISCELLANEOUS EQUIPMENT

Duplicate Deane duplex oil pumps furnish oil under pressure of 1100 lb. per square inch to a Wood accumulator for step bearings of main turbines, which operate at 700 lb. per square inch. Deane duplex oil pumps supply oil to valve gears and to upper and middle turbine bearings. An oil filter plant for the two main units and one Platt and one Blake priming pump are installed.

One brick stack 312 ft. high and 16 ft. in inside diameter is used in connection with the sixteen Babcock & Wilcox boilers. Another stack 200 ft. high and 21 ft. in inside diameter serves the eight Bigelow-Hornsby boilers.

Two Shaw electric cranes, one of 40 tons rating and the other of 50 tons rating, are installed in the operating room. The motors are operated on 600-volt direct current.

A General Electric engine telegraph system with 8-cp., 125-volt carbon incandescent lamps is installed.

The operating room is illuminated by forty-six 250-watt wall lamps and ten 500-watt gas-filled lamps mounted below roof trusses. The bus room is lighted by 60-watt tungsten lamps in holophane reflectors.

The Excitation of Synchronous Machines—I

Discussion of the Operating Characteristics of an Alternator—Derivation of Practical Curves on Exciter Rating, Rheostat Data and Field Current at Different Power-Factors

BY THEO. SCHOU

NOT long ago the machines made by different electrical manufacturers in this country varied in performance guarantees and characteristic design features. Some makers produced alternators with very close regulation, say 5 or 6 per cent, and this feature was considered attractive and used as a talking

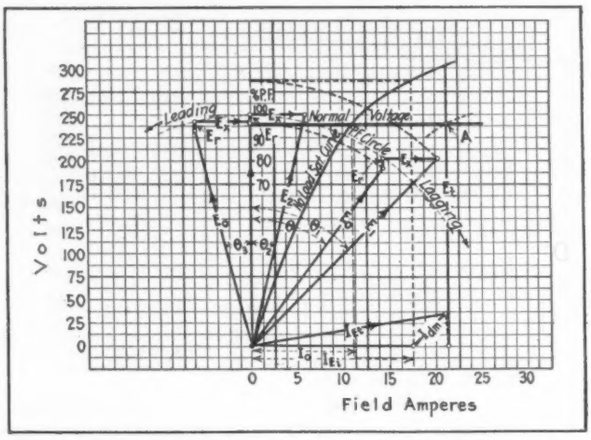


FIG. 1—RELATION BETWEEN VOLTAGE AND FIELD-CURRENT COMPONENTS IN SYNCHRONOUS GENERATORS

The unit is a steam-engine-driven three-phase, sixty-cycle, 300-r.p.m. Y-connected machine rated at 40 kva. and 240 volts and operating at full load with a lagging power-factor of 80 per cent.

point in selling them. In many cases the machine was underrated to give this close regulation at rated load, or was worked at a very high saturation factor to obtain such close regulation. Far from being a desirable feature, such close regulating machines have been found undesirable because of their sensitiveness and danger of break-down at possible short-circuits. Leading manufacturers take advantage of the automatic voltage regulator and turn out machines without in general specifying any regulation, thus improving the apparatus electrically and economically. The undersirable features of operating machines in parallel having different inherent characteristics are well known, and the tendency now,

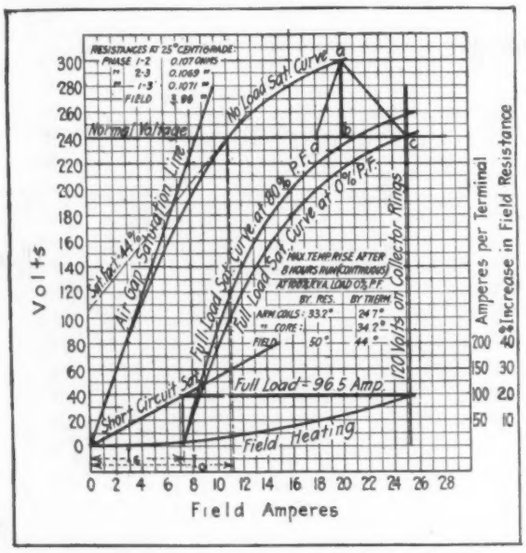


FIG. 2—PERFORMANCE CURVES FOR GENERATOR OF FIG. 1

thanks to work of the A. I. E. E. and the Electric Power Club, is to accept and live up to certain recognized standards to the benefit of all concerned.

In what follows here the writer will discuss machines having design features and performance characteristics that comply with the latest rules and suggestions of the A. I. E. E. and the Electric Power Club. The data and curves presented refer to sixty-cycle machines, of standard voltages up to and including 2400 volts, two-phase and three-phase, and alternators that will fulfill the following specifications:

The alternators will carry their full rated kilowatt load at 80 per cent power-factor, or 125 per cent of their full rated kilovolt-ampere load at 80 per cent power-factor, with a temperature rise not exceeding 50 deg. C. in armature and field.

The alternators will hold up voltage well at this rated kilovolt-ampere load at 80 per cent power-factor, with an exciter voltage available of 125 volts at the exciter busbars.

When operating at 125 per cent kilovolt-ampere load at 80 per cent power-factor, the excitation required in kilowatts will come well within the guaranteed exciter capacity of the alternator.

The alternators will operate successfully in parallel, having approximately the same short-circuit ratio and approximately the same magnetic characteristics.

No regulation guarantees apply, but the alternators are designed suitably for Tirrill regulator operation.

In order to discuss intelligently the proper excitation for various machines of different kilovolt-ampere rat-

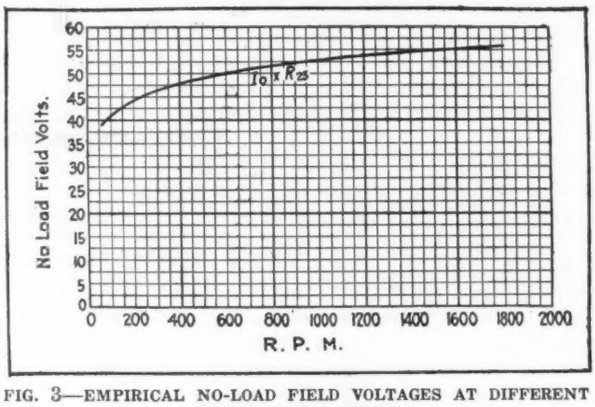


FIG. 3—EMPIRICAL NO-LOAD FIELD VOLTAGES AT DIFFERENT SYNCHRONOUS SPEEDS

ings at different synchronous speeds, it will be necessary to analyze in a practical way the vector diagram of an alternator. In Fig. 1 the vector E_o represents the full terminal voltage and, according to the saturation of the machine, calls for a field current I_o at no load. Under ordinary load, however, this field current must be increased in order to maintain normal voltage at the terminals. This increase of field current is to compensate for the ohmic drop in the armature winding, the reactance drop, and the demagnetizing effect of the armature ampere turns or the armature current on the field. Both the ohmic drop and the reactance, as well as the demagnetizing effect of the armature current, increase proportionally to the load of the machine or with the amperes per terminal, but whereas the ohmic drop will vectorially add (for a synchronous motor subtract) in line with the watt component of the armature current, the reactance drop will vectorially add in line with the wattless component, or at 90 deg. to the vector of the ohmic drop. The demagnetizing effect of armature current on field increases the lower the power-factor.

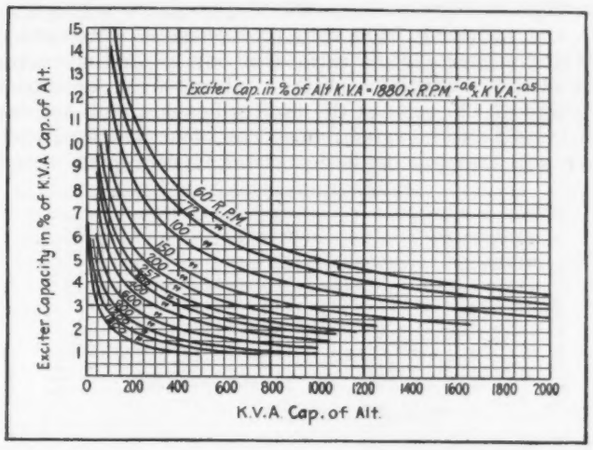


FIG. 4—RATIO OF EXCITER RATINGS TO THOSE OF ALTERNATORS

In Fig. 1 the vector diagram involving the above discussed guarantees is shown for a condition of full kilovolt-ampere load at a lagging power-factor of 80 per cent ($\cos \theta = 0.8$). This vector diagram refers to a three-phase machine, the commercial test curve of which is shown in Fig. 2. To the terminal voltage vectorially represented as E_o in Fig. 1 we add in phase with the watt component the vector representing the ohmic drop, $E_r = I \times R_{ph} \times \sqrt{3}$, where I = amperes per terminal and R_{ph} = resistance in ohms per phase. In phase with the wattless component, or at 90 deg. with E_r, we add vectorially the reactance drop $E_x = I \times X \times \sqrt{3}$, where X = reactance per phase computed in ohms.

The induced emf., E_1, with an internal phase displacement, θ_1, necessitates, according to the saturation or magnetic characteristic of the machine, a field current, I_{E_1}. This field current is required to maintain normal voltage at the terminals compensating for the ohmic and reactance drop at full-load amperes. The demagnetizing effect of the armature current at cos θ power-factor may be compensated for by a certain number of field ampere turns or field amperes (the turns remaining constant). This field current, I_{dm}, will vectorially add to I_{E_1} in phase with the induced emf. E_1. The resulting field current I_{Et} is the field current necessary to maintain normal voltage at the terminals at a power-factor of cos θ = 0.8, or at 80 per cent lagging power-factor and full kilovolt-ampere load. Point a is one point (at normal voltage) on the 80 per cent power-factor load curve, as shown in Fig. 2.

At unity or 100 per cent power-factor the demagnetizing effect of the armature current on the field is very small and is due to phase displacement caused by the reactance between the induced emf., E_1, and the armature current. At a certain leading power-factor, cos θ_2 —, the armature current would neither magnetize nor demagnetize the field, but merely distort it. If the leading power-factor be further increased, the armature current would tend to magnetize the field of the alternator. At zero per cent lagging power-factor, or if the current lags 90 deg. behind the emf., the demagnetizing effect of the armature current on the field of an alternator reaches its maximum since the flux set up by the armature ampere turns directly opposes the flux of the main poles. It is obvious that both the self-induction (armature reactance) and the armature reaction (demagnetizing or magnetizing effect of the armature current on the field), or the "synchronous reactance," as the combined effect of both has been termed, depend upon the current and phase displacement in its effect on the excitation of a synchronous machine. At lagging power-factors it will tend to demagnetize the field of an alternator, reaching its maximum demagnetizing value at zero per cent power-factor. At leading power-factors, however, it will tend to magnetize the field, reaching its maximum magnetizing effect at zero per cent leading power-factor.

Since in an alternator the rotation is against, and in a synchronous motor with, the magnetic attractions and repulsions between field and armature, it is obvious that, whereas lagging current will demagnetize the field of an alternator, it will magnetize the field of a synchronous motor.

Having detailed information as to the design, it is possible to calculate the effect of the "synchronous reactance" of any alternator at given kilovolt-ampere rating and power-factor, the result of such calculation, however, being only approximately correct. Various textbooks give more or less elaborate methods for calculating the above quantities, and space will not allow the writer to go into details concerning them in this article. A very simple test run, however, will give the exact value of the "synchronous reactance" at any desired load. If an alternator be run at short-circuit, it is evident that the field amperage necessary for gener-

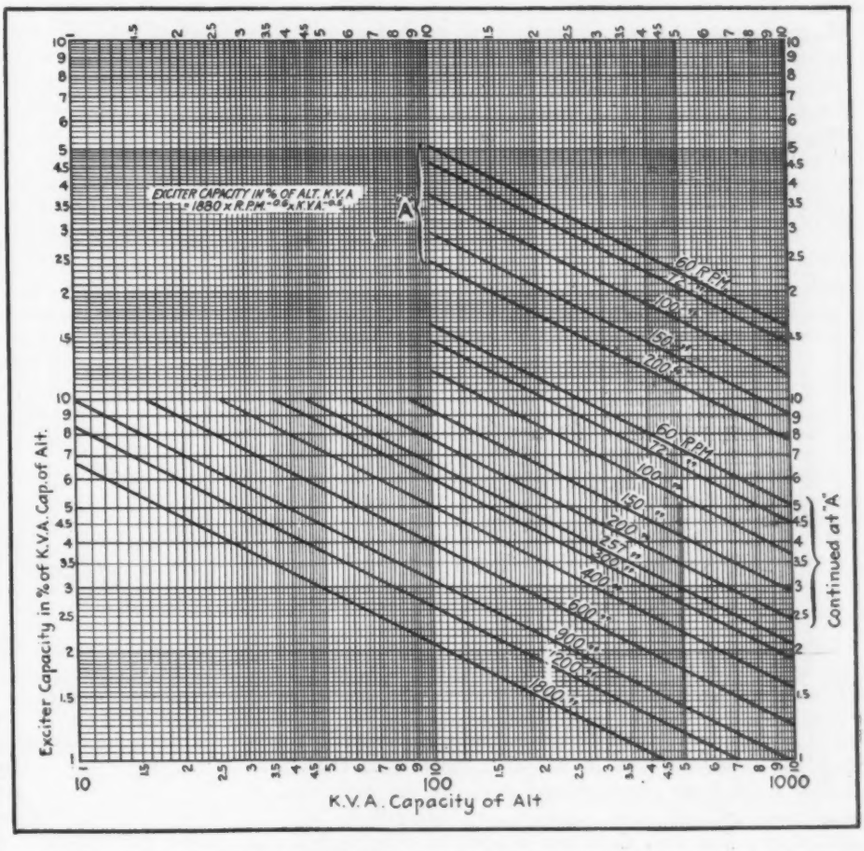


FIG. 5—CURVES OF FIG. 4 REPLOTTED TO SHOW THAT THE RATING OF AN EXCITER IS A LOGARITHMIC FUNCTION OF THE GENERATOR RATING

ating a certain current in the armature coils is just the field current required for overcoming the reactance and maximum demagnetizing effect of this current. It is obvious, therefore, that the field current, I_s (Fig. 2), which is the field current at full-load current in the short-circuited armature, is the field excitation necessary to overcome the "synchronous reactance" at normal-

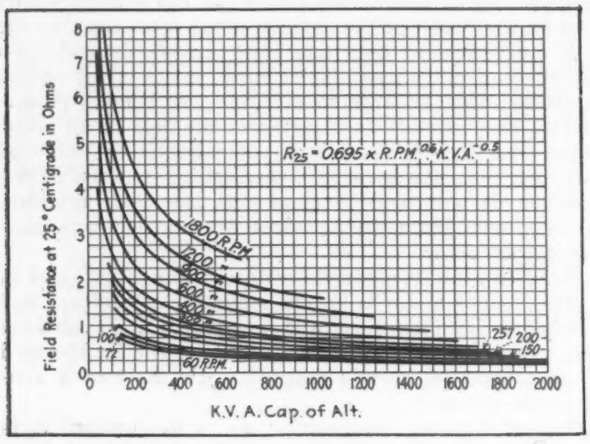


FIG. 6—"COLD" FIELD RESISTANCE OF ALTERNATORS HAVING VARIOUS RATINGS AND SYNCHRONOUS SPEEDS

current no voltage and will give the base point of the zero per cent, full-load-current power-factor curve.

If the full-load current saturation curve at zero per cent power-factor be taken as in Fig. 2, we have a simple method of obtaining the vectorial values of the reactance and demagnetizing effect. From point *c* on the zero per cent power-factor curve at full-load current at normal voltage lay off $I_s = cd$ along the normal voltage line. Draw *da* parallel to the air-gap saturation line. Then the projection of *da* on the voltage axis, or *ab*, represents the reactance drop in volts, and vector *bc* to scale of field amperes shows the field amperes necessary to overcome the maximum demagnetizing effect of the full-load armature current. The ratio between the no-load field current at normal voltage and field current at full-load current at short-circuit, or $I_o \div I_s$ (Fig. 2), is termed the normal short-circuit ratio of the alternator. Referring to the alternator test curve (Fig. 2), this ratio is $11.1 \div 7.2 = 1.54$. If an alternator should sustain a short-circuit while excitation was set at no load, full voltage, then the armature coils would be sub-

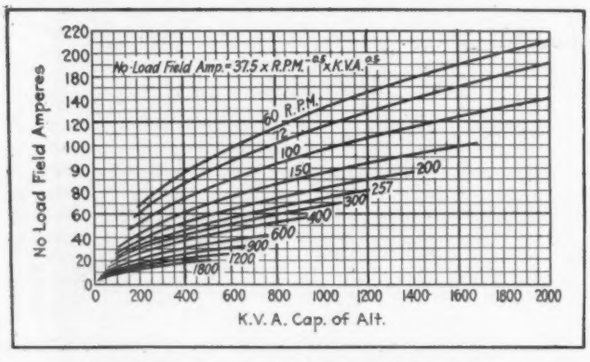


FIG. 7—NO-LOAD FIELD CURRENTS OF ALTERNATORS HAVING VARIOUS RATINGS AND SYNCHRONOUS SPEEDS

jected to a current equal to the short-circuit ratio times full-load amperes. It is obvious, therefore, that machines with high short-circuit ratio or close-regulation machines will be very sensitive to variations in field excitation, and also that the danger of ruining such a machine in case of short-circuit is great.

The following excitation curves and data are based on lines of sixty-cycle machines of standard voltages up to and including 2400 volts, two-phase or three-phase, having a short-circuit ratio of about 1.6 and operating as already outlined. With a given, fixed excitation voltage of 125 volts at the exciter busbars, and keeping in mind that the synchronous reactance and field leakage will increase with decreasing synchronous speed,

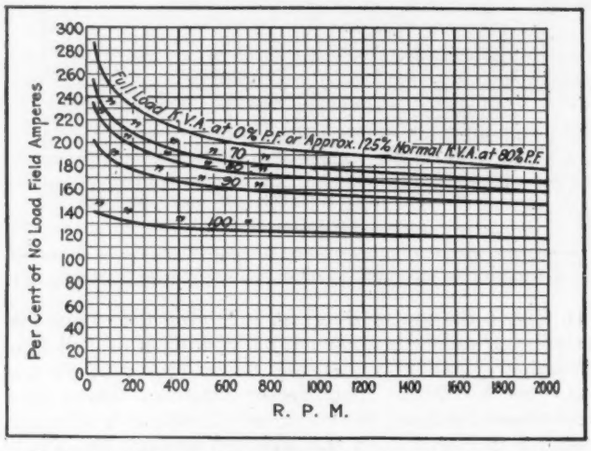


FIG. 8—FULL-LOAD FIELD CURRENTS AT VARIOUS POWER-FACTORS IN TERMS OF THE NO-LOAD FIELD CURRENT

it is evident that in order to hold up voltage at 50 deg. C. and rated kva. load the no-load field volts, or no-load field current at normal voltage times "cold" (at 25 deg. C.) field resistance, will not be constant for all synchronous speeds, but will be of lower value the lower the speed. In Fig. 3 the no-load field voltage, $I_o \times R_{25}$, is given at different synchronous speeds. This curve is, of course, empirical and based on experience with lines of sixty-cycle machines. Fig. 4 gives kilowatt exciter capacities in percentage of the kilovolt-ampere rating of alternators at various synchronous speeds. These curves will be of interest and practical use in estimating, designing and operating. The curves are also of empirical nature, being based on test results of many sixty-cycle machines at different ratings and synchronous speeds. They were originated by the writer in the following way in compiling the performance data for a complete line of sixty-cycle machines. The kilowatt exciter rating in per cent of the alternator kilovolt-ampere rating was plotted against the kilovolt-ampere rating of the alternators, and the curves thus

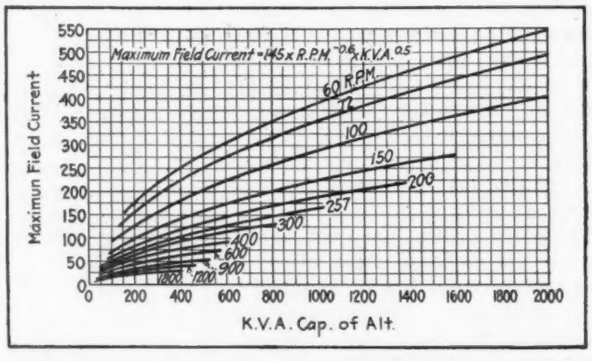


FIG. 9—COMPUTED MAXIMUM-FIELD CURRENTS FOR GENERATORS HAVING DIFFERENT RATINGS AND SYNCHRONOUS SPEEDS

obtained at various synchronous speeds showed a distinct tendency to follow a certain mathematical curve. The values were re-plotted on logarithmic paper and showed up as straight, parallel lines (Fig. 5). From these the equation for kilowatt exciter rating of alternators at various synchronous speeds was found to follow the law $Y = cZ^{-n} \cdot X^{-m}$, where Y is the exciter

capacity in per cent of kilovolt-ampere rating of alternator; C is found to be 1880; N is found to be 0.6; m is found to be 0.5; X is the kilovolt-ampere capacity of alternator, and Z is the synchronous revolutions per minute.

At the present time the writer has no mathematical proof of this equation, but he will welcome and appreciate the suggestions of other engineers.

When the exciter capacity and the no-load field voltage is given we can derive the complete rheostat information—that is, "cold" field resistance, no-load field current and full field current—of any alternator as follows:

$$Q = \frac{P}{R_{25} \times 1.19} \times P = \frac{P^2}{R_{25} \times 1.19},$$

where Q is the exciter capacity in watts; P is the excitation voltage (125 volts); R_{25} is the field resistance at 25 deg. C., and 1.19 is the constant compensating for 50 deg. C. temperature rise in the field as guaranteed. Or:

$$R_{25} = \frac{P^2}{Q \times 1.19} = \frac{125^2}{Q \times 1.19} = \frac{13{,}150}{Q}.$$

In Fig. 6 the "cold" field resistance in ohms of alternator fields at different kilovolt-ampere capacities and synchronous speeds of the alternators is given. These curves are, of course, also logarithmic, and the equation for the "cold" field resistance R_{25} was found in the same way as the exciter capacities.

$$R_{25} = 0.695 \times \text{r.p.m.}^{0.6} \times \text{kva.}^{-0.5},$$

where r.p.m. is the synchronous speed and kva. the capacity of the alternator. Further $I_o \times R_{25}$ can be found from the curve of Fig. 3. Therefore, I_o, the no-load field current of alternators, is found. Fig. 7 gives no-load field-current curves of alternators of various kilovolt-ampere capacities and synchronous speeds.

$$I_o = 37.5 \times \text{r.p.m.}^{-0.5} \times \text{kva.}^{0.5}.$$

Knowing the "hot" field resistance ($R_{25} \times 1.19$) and the exciter voltage at the collector rings (120 volts, allowing 5 volts drop in the brushes), the full-field or maximum-field current ($I_{max.}$) evidently may be computed for the same line of alternators as embraced in Figs. 4, 6 and 7.

$$I_{max.} = \frac{120}{R_{25} \times 1.19} = \frac{100.75}{R_{25}}.$$

Fig. 9 gives curves for $I_{max.}$

$$I_{max.} = 145 \times \text{r.p.m.}^{-0.6} \times \text{kva.}^{0.5}.$$

In a later issue of the ELECTRICAL WORLD another section of this article will appear, discussing the effect of changes in exciter voltage on the power-factor of synchronous motors and outlining an analytic method of computing the line current drawn by a motor.

Economics of Stoker, Economizer and Superheater

Points to Be Considered When Selecting and Installing Apparatus to Improve Boiler-Room Operations, Including Possible Benefits and Cost in the Average Plant

BY A. A. POTTER* AND S. L. SIMMERING†

ONE of the most important items when considering the economics of boiler-room operation is that of labor. In some boiler plants the coal must be handled three times before it reaches the fireman and the ashes four times before final disposal. Stoker firing saves as much as 40 per cent of the labor in large power plants when used with modern methods of coal storage and with coal and ash handling machinery. In medium-sized plants burning about 100 tons of coal per week the saving in labor is about 25 per cent. A stoker installation without automatic coal and ash handling apparatus would result in little saving of labor, but greater ultimate economy would be produced on account of the stoker permitting the burning of cheaper grades of fuel.

No stoker, however, will satisfactorily handle all classes of fuel. This fact, together with the interest on the investment, repairs, depreciation and power required for operating the stoker and auxiliaries, must be taken into account when considering the installation of stokers in a power plant. As a general rule, stokers of the front-feed type will give excellent results with the better grades of coal but will not handle satisfactorily bituminous coals rich in sulphur. For such fuels the underfeed stoker or some form of chain grate will give better results. Fuels which contain a high percentage of ash can be more easily handled by the chain-grate type of stoker.

The cost of upkeep will be higher for the stokers than for hand-fired furnaces. Under ordinary conditions the cost of upkeep per stoker per year should not exceed $30. One manufacturer of underfeed stokers gives figures for 319 stokers, the average repair cost in this case per year per horsepower rating of stoker being $0.0357. The cost of upkeep of a stoker is influenced by the size and composition of the fuel used. The presence of sulphur in the coal in the form of iron pyrites will produce clinkers, which will interfere with the stoker operation.

It is difficult to express by a single equation the cost of a stoker equipment, as the number of stokers required, the draft conditions, the class of fuel burned and other considerations cause a variation in the cost. The following equations apply approximately to equipments for not more than four boilers. The cost in dollars is expressed in terms of the boiler-horsepower served by the stoker.

1. Chain-grate stokers:

For boiler capacity of 300 b.-hp. or less,

Cost in dollars = 86 + 4.5 times the boiler-horsepower.

For capacities from 300 b.-hp. to 500 b.-hp.,

Cost in dollars = 450 + 3 times the boiler-horsepower.

2. Mechanical underfeed stokers:

Cost in dollars = 400 + 3 times the boiler-horsepower.

3. Mechanical front-feed stokers:

Cost in dollars = 325 + 3.2 times the boiler-horsepower.

BENEFITS WITH ECONOMIZERS AND THEIR COST

Of all the heat liberated during the process of combustion of the fuel in the furnace of a boiler, 10 to 15 per cent passes out of the chimney. All of this heat cannot be considered wasted, as the force of the draft is dependent upon the temperature conditions both inside and outside of the chimney. The function of an economizer is to utilize part of the heat in the flue gases on their way from the combustion chamber to the chimney.

In considering the advisability of installing an econ-

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†Assistant professor steam and gas engineering, Kansas State Agricultural College.

omizer in a power plant, it becomes necessary to take into account the loss in draft, the probable cost of draft apparatus and its upkeep, as well as the resulting gain due to an increase in the temperature of the feed water.

The saving in fuel due to increasing the feed-water temperature is expressed as follows:

Heat saving (per cent) $= 100(T - t) \div [H - (t - 32)]$.

In this equation T is the temperature of feed water after heating, t is the temperature of feed water before heating, and H is the total heat above 32 deg. Fahr. per pound of steam at boiler pressure.

Assuming a boiler pressure of 100 lb. gage and the temperature of the feed water leaving the economizer as 285 deg. Fahr., the saving in fuel varies from about 21 per cent for an inlet feed temperature of 32 deg. Fahr. to about 11 per cent for an inlet feed temperature of 175 deg. Fahr. As a general rule, the inlet temperature t should be not less than 100 deg. Fahr., owing to the sweating produced on the first row of tubes, which may result in rapid corrosion and short life of the economizer tubes if the temperature of the water entering the economizer is low.

A common rule is to consider a fuel saving of 1 per cent for each 10 deg. Fahr. increase in the feed-water temperature and a 20 deg. Fahr. reduction in the flue-gas temperature. The increased available boiler-horsepower on account of the use of an economizer can be expressed by the formula

$$\text{Hp.} = W(T - t)S \div 33{,}479.$$

In this equation W is the weight of flue gases passing per hour, T is the temperature of gases entering economizer, t is the temperature of gases leaving economizer, and S is the specific heat of the flue gases.

The weight and the resulting temperature of the gases entering the economizer are largely dependent upon the firing conditions, and each installation must be considered as an individual problem. An economizer will show the greatest saving in a boiler plant which is forced and which has a high rate of evaporation. It is usually not advisable to install an economizer in small stations.

In the majority of power plants the economizer takes care of the entire boiler-room load. In one of the largest and most efficient power plants economizers are installed on the unit plan, which means one separate economizer for each boiler. The results seem to indicate that this practice is preferable. The economizer on the "unit plan" operates a heating surface additional to the boiler and can be operated at its best efficiency, when the boiler is so handled as to have a high rate of evaporation. Besides producing a saving in fuel, the economizer offers an advantage in case of a sudden demand for steam because of the large quantity of hot water held in storage.

From 4 sq. ft. to 5 sq. ft. of economizer heating surface should be provided for each boiler-horsepower, and the heat transmitted per square foot per degree difference per hour is commonly taken as 3 B.t.u., provided the tubes are free from scale and deposits.

DATA USED IN ESTIMATING COST OF ECONOMIZER

Number of tubes	32 to 10,000
Heating surface per tube	12 to 13 sq. ft.
Capacity in pounds of water per tube	60 to 70
Cost of economizer (f.o.b. factory)	$8 to $10 per tube
Cost of economizer erected	$12 to $15 per tube

For convenience, the following formula is given, from which the draft pressure in inches of water may be calculated for a given height of chimney:

$$p = H[(7.64 \div Ta) - (7.95 \div Tg)].$$

In this equation H is the height of chimney in feet above grate, Ta is the absolute temperature of air, and Tg is the absolute temperature of chimney gases.

BENEFITS WITH SUPERHEATERS AND THEIR COST

Among the advantages to be gained by the installation of an efficient superheater may be included: (1) Absence of moisture in the steam; (2) decreased amount of cylinder condensation for reciprocating engines; (3) decrease in the work of the boiler; (4) greater economies for the steam engines and turbines.

It is possible to heat steam, provided that it is not in direct contact with the water in the boiler, to a temperature which exceeds that at which the steam is formed. Steam of a temperature greater than the saturated temperature corresponding to the pressure, as given in steam tables, is called superheated steam. The amount of heat necessary to produce superheated steam is found by multiplying the degrees of superheat desired by the specific heat of the superheated steam at the given pressure and temperature.

Superheaters are of two classes. The first class are the attached superheaters, which consist of coils of pipe placed in the path of the hot flue gases on their way from the boiler to the chimney. The principal objections to this type of superheater have been the drop produced in draft between the boiler and chimney and the variation in superheat with the load carried by the boiler. The second class of superheaters are those entirely independent of the boiler and are separately fired. With a separately fired superheater the steam can be superheated to any temperature. The attached superheater is more economical in fuel and is usually installed in power plants requiring moderate superheats.

The resulting gain in economy due to superheating may be taken as 10 per cent for the first 100 deg. Fahr. of superheat and about 4 per cent for superheats ranging from 100 deg. Fahr. to 150 deg. Fahr. above saturated temperature and at ordinary working pressures.

It must be remembered in this connection that additional heat must be supplied in order to superheat steam, and this heat can be made available only by the combustion of an increased amount of fuel. The additional fuel required to produce superheated steam will vary from about 2 per cent for superheats of 25 deg. Fahr. to 6 per cent for superheats of about 100 deg. Fahr., and about 12 per cent for superheats of 200 deg. Fahr.

The lowering in the steam consumption by superheating steam to about 100 deg. Fahr. for the several types of prime movers may be taken approximately as follows:

Simple engines, low speed	20 to 30 per cent
Simple engines, medium speed	15 to 20 per cent
Compound engines	10 to 15 per cent
Steam turbines	6 to 12 per cent

For moderate superheats about 3 sq. ft. of superheating surface will be required per boiler-horsepower.

The following equations give the cost of attached or built-in superheaters and are not applicable to the independent or separately fired superheaters.

For 100 deg. Fahr. of superheat,

Cost in dollars = 165 + 26 times the boiler-horsepower.

For 200 deg. Fahr. of superheat,

Cost in dollars = 52 + 3.5 times the boiler-horsepower.

For 300 deg. Fahr. of superheat,

Cost in dollars = 40 + 4.3 times the boiler-horsepower.

Another important fact, often overlooked when installing a superheater, is that piping ordinarily intended for saturated steam is not always suitable for superheated steam, especially if the superheat is as high as 150 deg. Fahr. Superheated steam causes increased strains in the piping and fittings, and should a poor quality of cast-iron fittings be used trouble will be experienced sooner or later. The increased use of steel fittings points to the fact that this class is highly desirable although somewhat more expensive than the cast-iron fittings. Double extra-heavy pipe is usually employed in installations using superheated steam.

Meter-Test Current from Portable Batteries

A Method of Securing Regulated Current for Testing Watt-Hour Meters and Similar Appliances from Nickel-Iron-Alkaline Cells, as Devised by the New York Edison Company

PORTABLE storage batteries with compact carbon rheostats attached have been adopted by the New York Edison Company to furnish the regulated current necessary for testing direct-current watt-hour meters rated at 50 amp. and over. The company has found this method far superior to the former method of connecting the test circuit in series with a water rheostat across the electric service supply line from the standpoint of speed in testing, convenience and safety. In fact, it was the objectionable features of the water rheostat—its bulk, inability to maintain a uniform current, liability of the hot salt solution spilling and damaging floors, and the precautions necessary when operating it in the field—that led to the development of the storage-battery method of testing instruments.

TYPES AND WEIGHTS OF OUTFITS FOR TESTING DIFFERENT SIZES OF METERS

Meter Ratings, Amp.	Test Outfit Employed	Weight Complete, Lb.
5 to 25 (incl.)	Resistance load box	7.75
Up to 75 (incl.)	Two type B-4 cells	22
Up to 150 (incl.)	Two type A-4 cells	38
Up to 300 (incl.)	Four type A-4 cells	74

Three sizes of portable units, each inclosed in a light substantial carrying frame, are being employed. The types of cells used in each outfit, the weight of each battery complete with rheostat and the ratings of meters which can be tested by each set are given in the accompanying table. When meters rated at more than 300 amp. must be tested the required number of the largest size of unit are connected in parallel. Since in testing meters with batteries current has to be forced through relatively low-resistance circuits consisting of the current coils of the meters, the standard test instruments, test leads and regulating rheostats, not more than 2.5 volts has to be impressed.

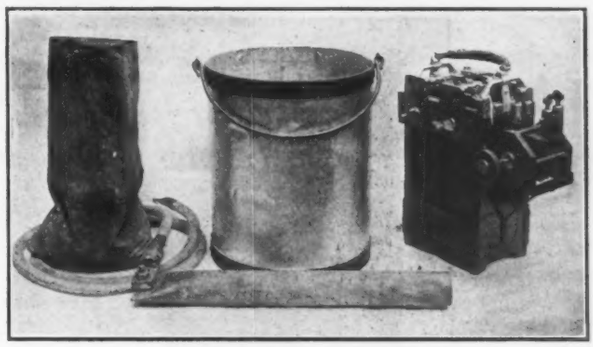


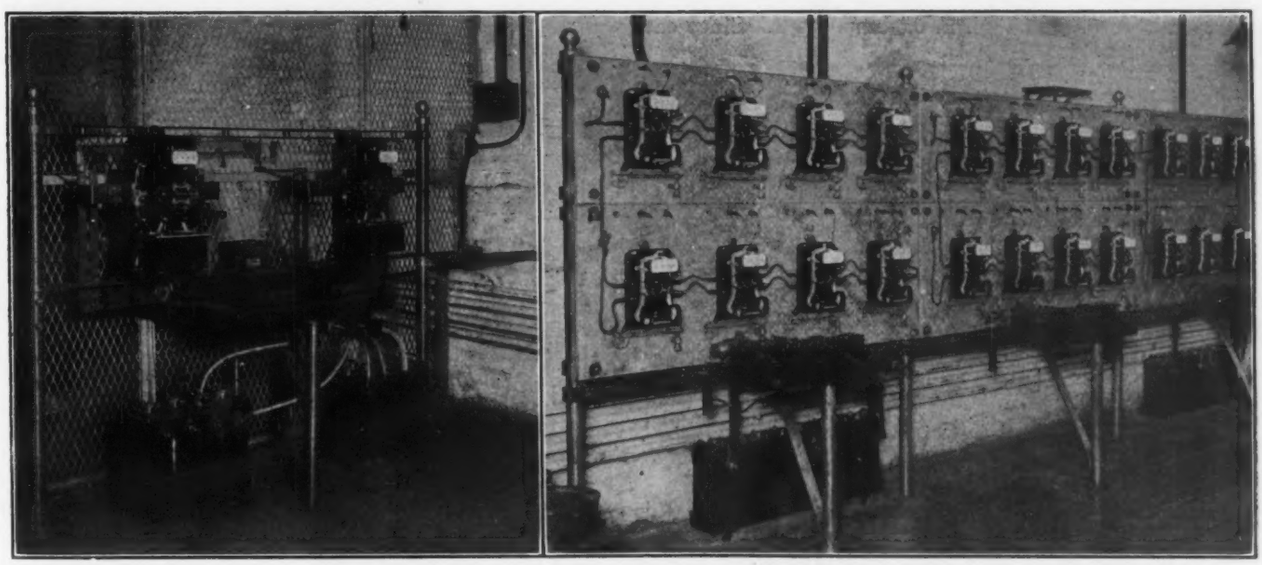
FIG. 3—COMPARISON OF PORTABLE BATTERY OUTFIT WITH SUPERSEDED WATER-RHEOSTAT CONTAINER AND ACCESSORIES

On the left is a canvas bag which was used for carrying salt. In front of the pail, which served as an electrolyte container and also as one electrode, is the other electrode consisting of a pipe with a wood plug in the end which rested on the bottom of the container during normal operation to prevent short-circuit.

Attached to each battery are two screw-operated carbon-plate rheostats, one of which permits coarse graduations in current and the other finer regulation. The construction of this rheostat is shown in Fig. 6. These two rheostats are connected in multiple with each other, but in series with the battery circuit, and are assembled in compact form, so they add very little to the over-all dimensions of the battery. Being connected between two adjacent cells, one battery connector is eliminated.

Nickel-iron-alkaline cells were selected because of their relatively small weight, extreme ruggedness and ability to carry large overloads. The latter characteristic is particularly necessary because the cells are frequently required to carry five times rated current without injury. The ampere-hour rating of the batteries is a secondary consideration on account of the fact that the batteries may be charged every night.

The two smaller sizes, being light in weight, are carried by the meter tester's assistant. The 200-amp. to



FIGS. 1 AND 2—LARGE-METER AND MEDIUM-SIZE METER TEST BOARDS WITH STORAGE-BATTERY SUPPLY

The equipment on the left is for testing meters rated at 100 amp. to 4000 amp., and the panelboard on the right is equipped for testing smaller meters rated at 5 amp. to 75 amp. The nickel-iron-alkaline batteries situated beneath the boards are supported on wheel trucks so that they may be moved for inspection.

300-amp. units, however, are a two-man load, so they are delivered by electric vehicles to the places where tests must be conducted and are carried by hand only between adjacent test points.

Every night the portable battery sets are returned to the district offices and charged automatically, the current being interrupted at the end of a definite period by automatic time switches. Since the 100-amp. to 150-amp. sets contain cells of the same ratings, they are charged in series from a 120-volt supply system by inserting resistance to control the current. The 50-amp. to 75-amp. sets, consisting of different-type cells, are charged in a separate group.

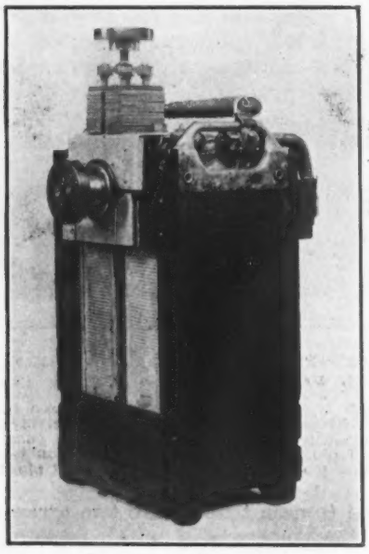


FIG. 4—STANDARD 150-AMP. UNIT WITH CARBON RHEOSTATS

Meters rated at 25 amp. and less are loaded by connecting their current coils in series with special portable load boxes across the electric-service supply line. These boxes are not used for larger currents since the amount of radiating surface required would compel the use of units too heavy for one man to carry. The load boxes are constructed of sheet-metal angle frames containing resistance elements and are provided with six switches which permit varying the current value from 0.5 amp. up to 25.5 amp. in 0.5-amp. steps. Since each load box weighs only 7.75 lb. and measures 8 in. wide by 15.5 in. long by 4 in. deep, they are carried in 15-in. by 20-in. fiber cases with tools, leads and other testing accessories. These boxes were developed by the New York Edison Company and are manufactured by the General Electric Company.

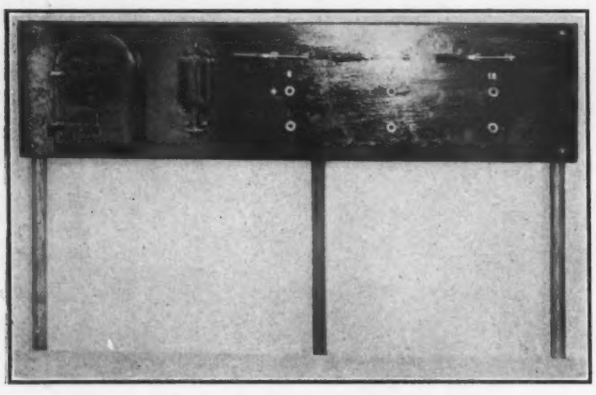


FIG. 5—TYPICAL DISTRICT CHARGING BOARD

Nickel-iron-alkaline cells are also being employed by the New York Edison Company for supplying test current in the meter laboratories. Meters rated at 100 amp. to 4000 amp. are tested on one board, and those rated at 5 amp. to 75 amp. inclusive on a different board. These boards are shown in Figs. 1 and 2. The large-capacity board consists of two upright columns on which are two horizontal bars, the lower one being stationary and the upper adjustable as to height so that meters of any size may be attached thereto for support.

Back of each meter position, of which there are two, are a pair of slotted vertical busbars to which any type of meter may be connected by short straps or jumpers. In front of the board between meter positions is a table provided for the calibrating standards. Two sets of cells are provided for this board—one being connected directly with the busbars without any current regulator in series (the internal resistance of the cells limiting the current). The other set is joined with the busbars by a carbon-disk rheostat to permit current gradations.

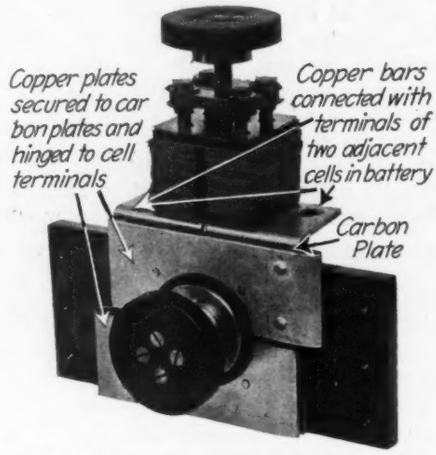

Copper plates secured to carbon plates and hinged to cell terminals
Copper bars connected with terminals of two adjacent cells in battery
Carbon Plate

FIG. 6—DETAILS OF RHEOSTATS EMPLOYED WITH PORTABLE SETS

Each of the batteries employed with the other testing board is connected to supply current to sixteen meter positions, the current being regulated for each set of eight meter positions by carbon-disk rheostats. Auxiliary switches are provided in order that these batteries may be connected in series with a common charging board. The batteries are mounted on wheeled trucks and may thus be moved into a convenient position for inspecting and filling.

FIG. 7—PORTABLE RESISTANCE-LOAD BOX

Performance of an Underfeed Stoker Installation

Method of Conducting Eight-Hour Test and Results Secured at Standby Steam Station of Roanoke (Va.) Railway & Electric Company

BY W. G. CLAYTOR[1] AND S. S. WILLIAMS[2]

THE results of an eight-hour test conducted recently at the Walnut Avenue generating station of the Roanoke Railway & Electric Company to ascertain the performance of boilers equipped with new Westinghouse five-retort underfeed stokers are given in the accompanying tabulation. The data show that an evaporation factor of 1.1164 was obtained when burning 36.63 lb. of dry Pocahontas pea coal per square foot of grate surface per hour, and that 7.0367 lb. of steam at 161.3 lb. pressure and 132.6 deg. superheat was generated per square foot of heating surface per hour with feed water at 182.2 deg. Fahr. The combined efficiency of the boiler, furnace and grate was 74.23 per cent, while the boilers developed 261.86 per cent of their rating based on 30-lb. equivalent evaporation.

REMARKS ON PERFORMANCE

It may be pointed out that the newly equipped boilers, in conjunction with the vertical turbo-generators which are installed, permitted securing an economy of 2.261 lb. of coal per kilowatt-hour generated. Only the prime movers are supplied with steam from the boilers, another unit being used to carry the auxiliaries. This high economy is also partly attributable to operating the boilers and turbo-generator at constant load near the rating which gives the highest efficiency, a condition which is ideal and seldom obtainable in practice.

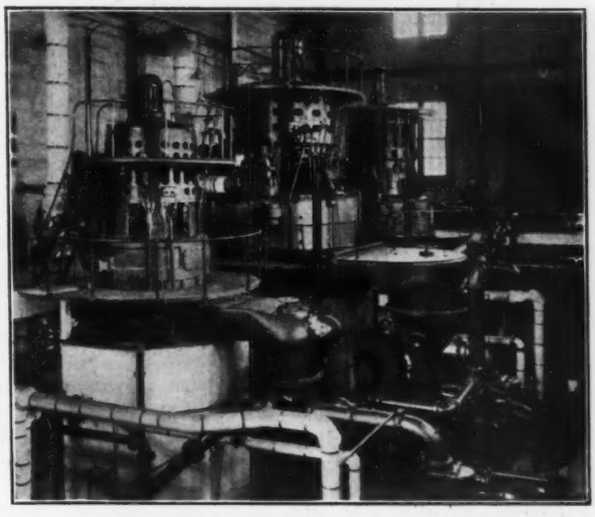
The relatively poor draft pressure obtained in the breeching throughout the test was probably due to the condition of the dampers on three other boiler furnaces discharging into the same stack as the one under test and to leaks around connections between brick and steel work of the boiler settings and breechings. After the test the boiler and furnaces were inspected. Several of the coal pushers on the lower part of the grate were slightly burned, but, according to the stoker manufacturer, since these burned parts project into the fuel bed their burning away does not damage them or prevent their performing their duty. All other parts of the furnace and stoker were reported to be in good condition.

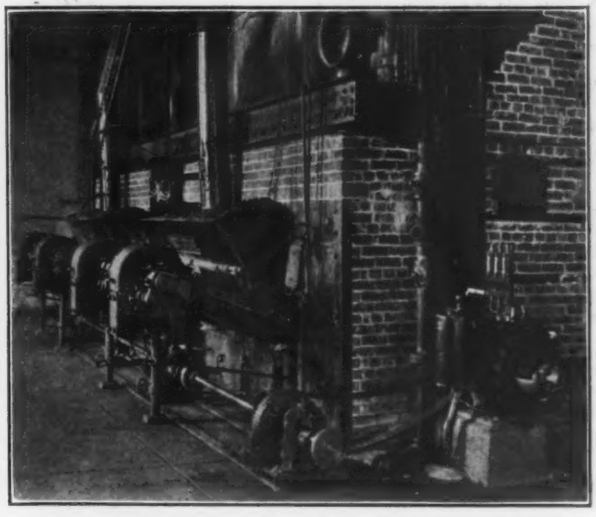
METHOD OF CONDUCTING TEST

Prior to the test the boilers were inspected to see that they were free from adhering scale. Then the flues were blown out, the combustion and soot chambers were cleaned, and the steam gage was tested. Instead of weighing the water fed to the boilers, as is usually done, the amount of steam generated was measured by a General Electric type FS-4 steam-flow meter, which was checked in place by the water-column method and found to be within 0.5 per cent of accuracy. During the test coal was drawn from the overhead coal bunkers and weighed in a special box placed on a Howe platform scale placed above the stoker hoppers, allowing the box to be dumped directly into the hoppers. The temperature of the steam was measured with thermometers inserted in oil-filled pockets in the steam line about 24 in. from the boiler stop valve. Feed-water temperature was measured by placing a thermometer directly in the water above the feed pump. Pyrometers which were installed in the breeching about 12 ft. from the boiler uptake were employed to obtain the flue-gas temperature.

The first readings were taken after bringing the boiler up to working condition; that is, with full load and with full fire on the grate. Thereafter readings were taken every fifteen minutes. Small samples were taken from each lot (658 lb.) of coal weighed and representative amounts selected for analysis. At the conclusion of the test all of the ash which had accumulated

[1]General superintendent Roanoke Railway & Electric Company, Roanoke, Va.
[2]Chief engineer of power stations.





FIGS. 1 AND 2—PART OF THE GENERATING EQUIPMENT AND UNDERFEED STOKERS IN ROANOKE (VA.) STATION

These three vertical-type turbo-generators constitute a part of the generating equipment. They are rated at 2500 kw., 1500 kw. and 500 kw., respectively, and all are equipped with jet condensers. The remainder of the generating equipment includes two 35-kw. turbine-driven exciters. Three-phase, sixty-cycle energy is generated at 2300 volts. The stokers shown are of the five-retort Westinghouse underfeed type and are installed under Babcock & Wilcox boilers. They are driven through a line shaft and silent chain by the motor shown in the foreground. The stokers consist of a series of inclined retorts made up of fuel troughs separated by parallel inclined tuyère boxes. Coal is fed in at the top of the inclined retorts and is pushed forward by secondary rams attached to main rams by lost-motion connections. Any ash which is formed is forced onto a discharge grate by a moving grate section. The formation of objectionable clinkers along the sidewalls is minimized by introducing air through special side tuyères.

DATA AND AVERAGE RESULTS OF EVAPORATION TEST, WALNUT AVENUE STATION, ROANOKE COMPANY

Make of boiler	Babcock-Wilcox
Type	Water tube
Area of water-heating surface	5000 sq. ft.
Builder's rating	500 hp.
Area of grate	100 sq. ft.
Make of stoker	Westinghouse five-retort underfeed
Kind of coal	Pocahontas pea (American Coal Co.) $2.50 per ton

COAL ANALYSIS

	As Fired, Per Cent.	Dry Basis, Per Cent.
Volatile combustible matter	18.79	19.913
Fixed carbon	72.50	73.224
Ash	7.76	7.840
Moisture	1.02	.....
B.t.u.	13,878.0	14,022.0

ASH ANALYSIS

	Per Cent.
Volatile matter	2.480
Fixed carbon	32.260
Ash	65.250
B.t.u. (estimated)	5300.0

AVERAGE PRESSURES

	Lb.
Steam (gage)	161.3
Barometer (inches)	29.0
Steam (absolute)	175.419
Forced draft under grate (inches draft-gage oil)	4.036
Draft over fire	0.0437
Draft in uptake to breeching	0.4253

AVERAGE TEMPERATURES

	Deg. Fahr.
Boiler room (deg. Fahr., taken at 5:30 p. m.)	82.00
Flue gases in breeching	494.40
Feed water	182.20
Steam	503.90
Degrees superheat	132.60

FUEL DATA

Weight of coal as fired (pounds)	29,610.0
Percentage of moisture in coal (from analysis)	1.02
Weight of dry coal (pounds)	29,308.0
Weight of ash and refuse (pounds)	2372.0
Percentage of ash and refuse in dry coal	8.09
Weight of combustible burned (pounds)	26,938.0
Total weight of steam (from flow meter)	281,470.0
Factor of evaporation	1.1164
Total weight equivalent water evaporated from and at 212 deg. Fahr.	314,223.0

RATES OF CONSUMING FUEL IN GENERATING STEAM

	Lb.
Dry coal consumed per hour	3663.5
Combustible consumed per hour	3367.25
Pounds steam per hour	35,183.75
Dry coal consumed per square foot of grate surface per hour	36.63
Combustible consumed per square foot of grate surface per hour	33.67
Pounds steam per square foot of heating surface per hour	7.0367

EVAPORATION PER UNIT OF FUEL

	Lb.
Water evaporation per pound coal as fired	9.5059
Water evaporation per pound dry coal	9.6035
Water evaporation per pound combustible	10.4562
Equivalent evaporation per pound coal as fired	10.6123
Equivalent evaporation per pound dry coal	10.7274
Equivalent evaporation per pound combustible	11.6654

BOILER PERFORMANCE

Evaporation per hour from and at 212 deg. Fahr.	39,279.1
Boiler horsepower developed (30 lb. basis)	1309.3
Percentage of boiler rating developed	261.86

EFFICIENCY OF STEAM GENERATION

	Per Cent.
Efficiency of boiler, furnace and grate	74.23

TURBINE AND GENERATOR DATA

Average vacuum (inches)	27.124
Average temperature condenser injector water	45.575
Average temperature condenser discharge	71.484
Average kilowatt-hours generated per hour	1627.5
Total kilowatt-hours generated	13,100.0
Pounds of coal per kilowatt-hour (without auxiliaries)	2.261

in the ash pit was weighed on the scale previously used for weighing the coal. Analyses were made from a sample made up of small amounts taken from every wheelbarrow load.

The test was made by the regular station crew, one man being employed to weigh coal, another to take readings of steam flow, draft gages, flue-gas and steam temperatures and record data, and one fireman, under a representative of the stoker manufacturer, to handle the fire and stoker. Engine-room attendants took readings of incidental temperatures and recorded generation data.

The station in which the stokers are installed serves

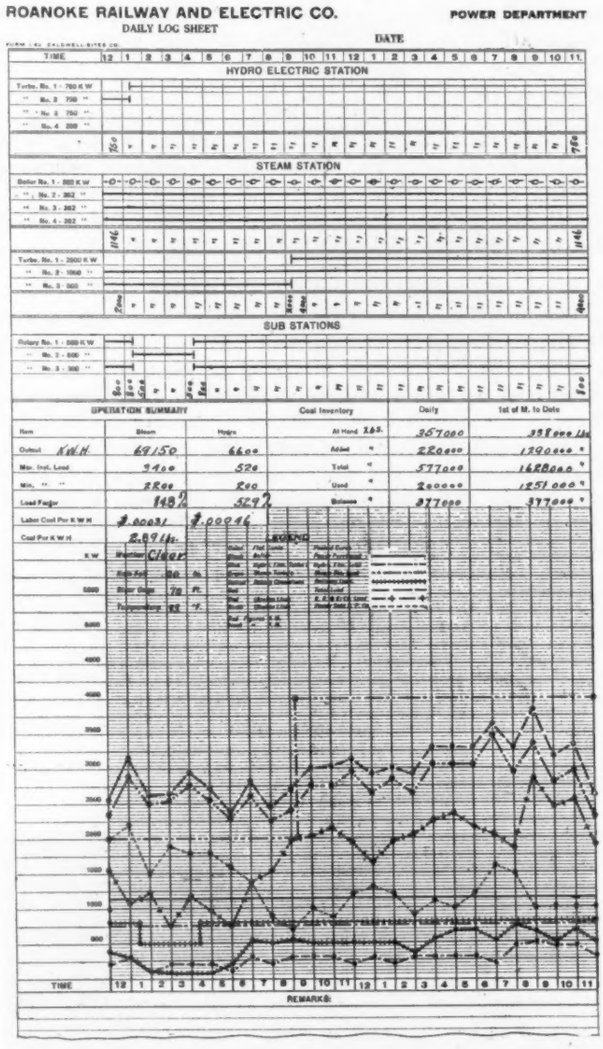


FIG. 3—LOG SHEET SHOWING CHARACTERISTICS OF ROANOKE COMPANY'S LOAD AND OPERATING PERIODS OF STATION EQUIPMENT

as an auxiliary to the Roanoke company's hydroelectric station in case of emergency or low water. Since 1907, when the steam station was built with an initial equipment of one 1500-kw. and two 500-kw. Curtis vertical turbines, the load has increased rapidly. At first the entire load was carried by one 500-kw. machine. Now conditions are different, as shown by the accompanying log sheet for July 30, 1915. The peak load at present is much higher, however, than the one shown on this log sheet.

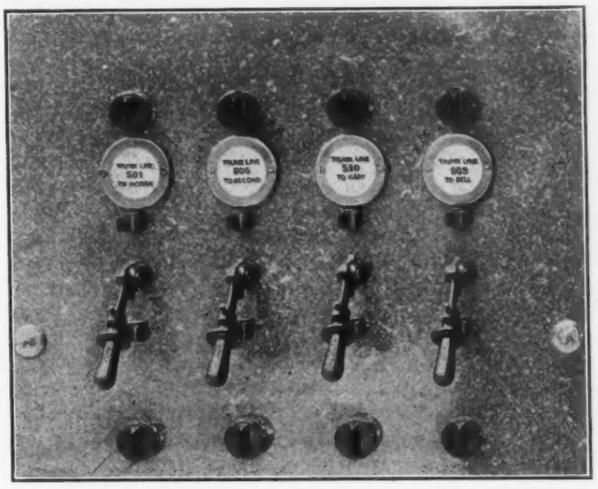
The average cost of coal delivered at the plant is $2.50 a ton. Yard space is provided for the storage of 1200 tons. About 160 tons of coal are required every twenty-four hours.

STATION AND OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Type of Name-Plates Used on Apparatus in Conners Creek Power Station

In the new Conners Creek power house of the Detroit Edison Company every switch and piece of apparatus that requires a number or other designation is labeled with a neat and readable card securely held behind glass in a round metal frame. On the large switchboards and larger apparatus name-plates like those shown in the



SWITCHBOARD NAME-PLATES WITH PRINTED CARDS HELD BEHIND GLASS

accompanying illustration are used. On smaller machines and on panelboards smaller but similar plates are installed, so that on the whole the name-plates throughout the plant are uniform, present a neat appearance, and are suited to the apparatus on which they are installed.

Construction Features of a 2000-Kw. Motor-Generator Installed by Pacific Gas & Electric Company

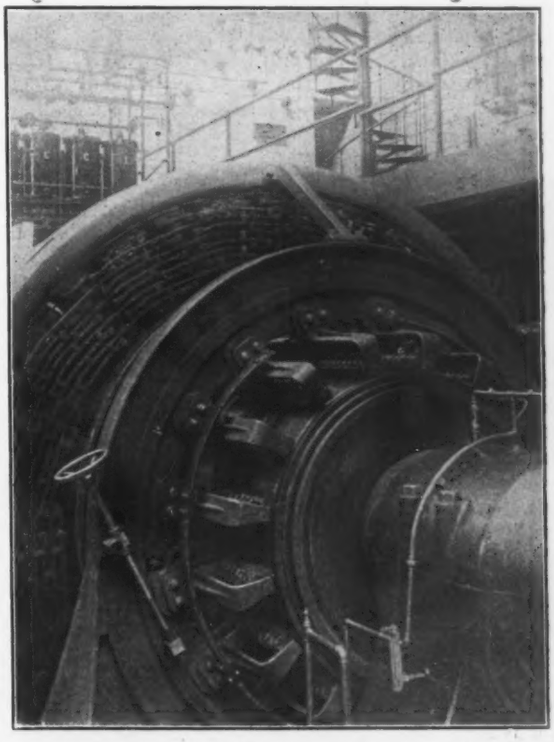
There has recently been installed at station C of the Pacific Gas & Electric Company, Oakland, Cal., a 2000-kw. motor-generator set which is one of the highest rated units of its kind west of the Mississippi. It consists of a 11,000-volt, three-phase, sixty-cycle synchronous motor and a 275-volt, 2000-kw. shunt-wound, commutating-pole generator which embody interesting features of construction.

To carry the full-load current, which is about 8000 amp., and provide sufficient radiating surface, the commutating-field poles were wound with soft annealed copper strips wound on edge and connected in multiple. It was impracticable to use solid conductor because a cross-section of 8 sq. in. was required. On account of the current which had to be commutated and the high peripheral speed of the commutator the bars had to be arch-bound midway between each end by three shrink rings of high tensile strength. Both ends of the commutator are bored to a slight taper and rest on similarly tapered steel rings held together by bolts. This construction allows the commutator bars to expand lengthwise when heated without distorting the shape of the commutator. On account of the length of the commutator a brush-holder yoke is placed midway of it and the brush forks are attached so they extend toward each end. Even with this construction they are relatively long, so that the forks were made of cast iron to give rigidity and copper-plated to improve conductivity.

All parts of the brush rigging are made comparatively heavy to absorb the small vibrations set up by the 250 brushes in the commutator. Box-type brush holders are employed which are split through the center and hinged on one side so any holder can be removed without disturbing the others.

Each armature conductor consists of eight square wires in multiple, insulated from each other to reduce eddy-current loss, which would be considerable with solid conductors of the cross-section required. The coils are insulated with mica, fish paper and cotton tape, which are hot-pressed and impregnated with an oil-proof and moisture-proof compound. Deflectors are attached to the front end of the commutator and the rear ends of the armature to force air past the current-carrying parts.

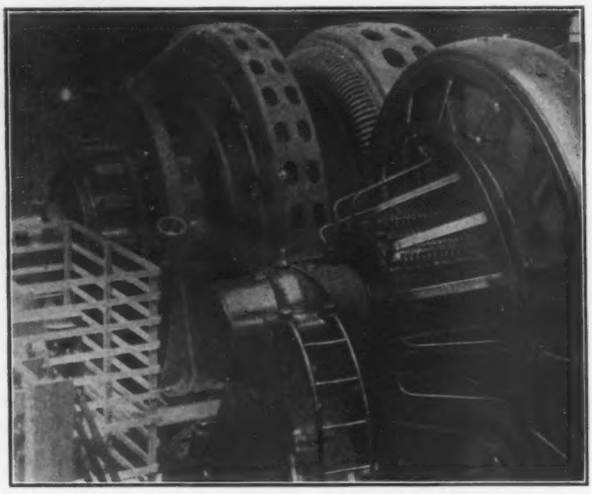
The stator yoke of the synchronous motor, which is of cast iron and of box section, serves as a support for the laminated stator core but forms no part of the magnetic circuit. The ends of the stator coils, where they project beyond the core, are securely supported to prevent distortion in case of a sudden short-circuit. Around



COMMUTATOR END OF 2000-KW. MOTOR-GENERATOR SET

the rotor spider, which consists of cast iron, is a steel rim to which the pole pieces are dovetailed. With this construction all stresses due to centrifugal force are counteracted by the steel rim, while the shrinkage strains which would exist in a one-piece spider cast with arms are avoided.

An inclosing shield is provided on the side of the



RELATIVE SIZE OF NEW 2000-KW. AND OLD 1000-KW. MOTOR-GENERATOR

motor next to the generator, so that air may be taken in only at the bearing end and directed around the poles and through the stator winding and core. Thus the motor as well as the generator has its independent system of ventilation.

Although the rotating element of the set weighs 46 tons, only two bearings are used. Each pedestal is provided with a large oil reservoir with openings to permit the circulation of air for cooling. The bearings are ring-oiled, but to insure adequate supply of oil the flooding system is used. Small gear pumps, belted to the shaft, carry oil from the reservoirs in the pedestals to the tops of the bearings.

This motor-generator set, while rated at 2000 kw., occupies a floor space of only 13½ ft. by 21 ft., which is but slightly more than the space occupied by the 1000-kw. sets of the same speed previously installed in the same station.

Value of Providing Adequate Transmission-Line Insulation

There is no case in the engineering field where attention to slight improvements has been accompanied by or can produce more beneficial results than in the design and fabrication of insulators, according to A. O. Austin, chief engineer of the Ohio Insulator Company. Only small modications in shape will change the flash-over value and prevent internal stresses, while the elimination of impurities in materials and imperfections due to molding will minimize mechanical failures and electrical break-down. By minimizing depreciation, particularly, can great advances be made, since only a slight reduction will increase the value of an insulator in a much greater proportion, whereas an increase might make an insulator worthless.

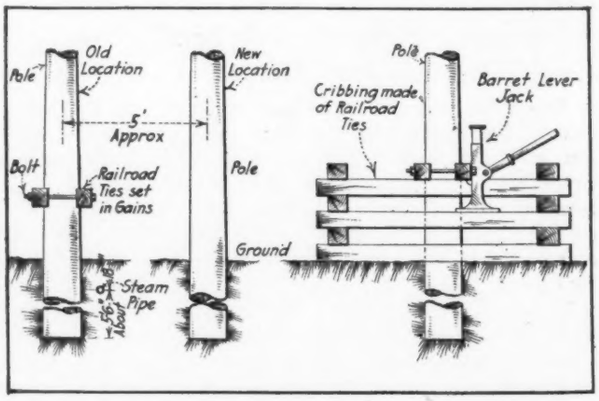
Interruptions to service become especially objectionable when the load on a system grows, therefore it is more advisable to invest money in appropriate insulators to begin with than to spend money in patching up a system after damage is done. A slight increase in safety factor will decrease interruptions in a much larger proportion. Safety factor means nothing, however, if based on the operating voltage, because lightning is the ruling factor. Insulators are the "safety valves" of transmission systems, therefore it is far better for them to "spill over" than to puncture, provided that they are free-arcing, because relays or arc-suppressing devices can be set to interrupt the power arc before it has done any damage. Thereupon service may be immediately restored, whereas a punctured insulator may cripple the entire line. When increased reliability of operation is desired Mr. Austin maintains that it is usually better to weed out defective insulators or reinsulate entirely than to build duplicate lines. If the insulators are designed with sufficient factor of safety, no occasion for trouble should arise for years to come. In the near future probably many of the 50-kv. to 60-kv. lines will be reinsulated with 110-kv. insulators to make them lightning-proof.

How a Pole Was Moved Over an Obstruction While Circuits Were Alive

By A. C. Hewitt

A severe test of a lineman's ingenuity is frequently made when he is called upon to undertake a job on short notice where he is forced to resort to main strength and awkward methods because time does not permit him to get together the necessary tools or materials to do the work in the easiest way. One such problem presented itself to a lineman in Illinois a short time ago. His company operates a 33,000-volt system, and in one city this transmission line enters on 70-ft. wooden poles at the edge of the "Big Four" railroad right-of-way. A new warehouse building was being erected adjacent to the railroad and so close to the high-tension line as to cause some alarm for the safety of the building contractor's men. It was decided that two of the 70-ft. poles should be moved about 5 ft. Under ordinary conditions the job was a comparatively easy one, as a trench could be dug and the poles moved to their new location by barring into place in the trench.

In this case conditions prevented moving the poles in the usual way—first, because of the proximity of the main track of a railroad, with passing trains every hour or so; second, because the power company could not "kill" the high-tension line at this place without great inconvenience to their customers, and the poles, therefore, had to be moved with the lines alive; third, when the



ARRANGEMENTS TO MOVE A 33,000-VOLT TRANSMISSION-LINE POLE OVER AN OBSTRUCTION WHILE CARRYING LIVE CIRCUITS

trench was dug, a 2-in. steam pipe about 1 ft. from one of the poles and 1 ft. under ground was found which could not be disturbed.

Arrangements were accordingly made to raise this

pole over the steam pipe as follows: Two sound railroad ties were procured and the pole was gained about ¾ in. deep. The ties were bolted together as in a double-arm construction and a track jack was put under one end so that the pole could be lifted high enough to get another tie under the first two. The jack was then moved to the other side of the pole and the process repeated. As the pole was lifted out of the ground cribbing was built up under the bolted ties, as shown in the accompanying diagram. When the pole butt was high enough to clear the steam pipe bars were used to move the pole across the pipe. When the new location was reached the pole was lowered in the same manner that it had been raised. During the moving process rope guys were attached to the pole to steady it.

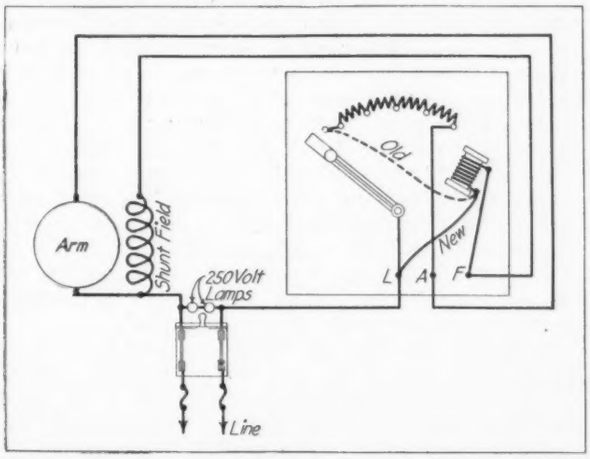
With eight men the actual time required to move a distance of about 5 ft. the two 70-ft. poles, one as described above and the other by ordinary trenching, was approximately six hours. This time included digging of trenches, the actual moving and the back-filling.

Changing Connections of a Motor Starter to Improve Starting Conditions

BY B. C. RATHBUN

The article taking up shunt motor-starter connections on page 1317 of the Dec. 11 issue of the ELECTRICAL WORLD and the comments by Leonard Kebler on page 265 of the Jan. 29 issue are of interest to the writer on account of an experience with a starter similar to the one discussed. As mentioned by Mr. Kebler, the inductive discharge when opening the main switch with the scheme originally published is a strong argument against the arrangement. The connections used, however, may have proved the only practicable way out of the difficulty encountered.

As another illustration, the writer offers an experience when called to inspect a 2-hp., 500-volt shunt motor operated in a factory. The installation was of a temporary character to relieve conditions caused by a fire. The motor was an old bi-polar machine with cast-iron frame and required a large field current. It was situated some distance from the starter and used to operate a cut-off saw from a counter shaft. The nature of work handled by this machine called for starting and stopping of the motor several times a day. The inertia of the machine was considerable so that a weakening



MOTOR-STARTER CONNECTIONS THAT IMPROVED OPERATING CONDITIONS

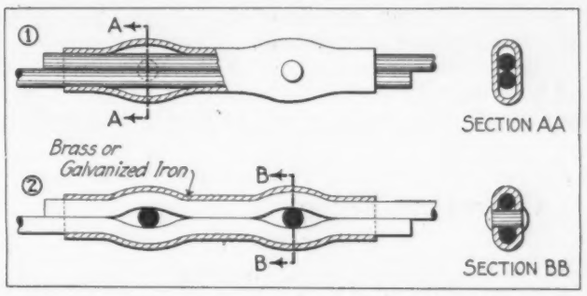
of the motor field as the motor starter handle was pulled over often caused a flashing at the commutator before reaching full speed, with blowing of many fuses and roughening of the commutator.

Time and expense were important considerations in the case, so that the connections at the starter were changed as shown in the accompanying diagram. The field was thus placed across the line and two 250-volt lamps of low candle-power were connected in series across the upper contact of the main switch as a field discharge resistance. A field-discharge switch would have saved the energy used by the lamps, but it was not available. The lamps were used to notify careless operators to pull the switch in stopping the motor instead of knocking the starter handle loose from the magnet as is often done. With this arrangement the motor started much better than before, and the field insulation was safer from injury due to inductive discharge.

Convenient Method of Making a Solderless Conductor Joint

BY EMILE PIEPEL

The accompanying diagram shows a scheme for connecting wires and cables used during construction work on plants that results in a good electrical and mechanical joint without the use of solder. The outside sleeve may be made from brass or galvanized iron at a price lower



A WIRE CONNECTOR CONSISTING OF A BRASS SLEEVE AND TWO RIVETS

than the materials and tools required for soldering. The only tools required when applying this connector are a punch and a hammer.

The wires are introduced in the connector as shown in the diagram at 1. A punch is then inserted in the sleeve hole to spread the wires apart as shown in the sketch at 2. A copper rivet is then inserted and riveted down so as to hold the wires in the position shown and at the same time pinch the connector around the conductors. This type of connector is mechanically strong and has greater carrying capacity than a soldered connection.

A Method of Computing Leakage in Hot-Water-Heating Systems

All hot water returned from the heating system of the Coshocton (Ohio) Light & Heating Company, an Ohio Service Company property, flows by gravity into a sump from which it is periodically pumped back into the boilers for reheating. To measure the amount returned and thus keep a check on leakage, an old street-car register has been attached to the sump float which controls the starting and stopping of the pump. In this way a record is kept of the number of times the pump is started. By experiment, it has been found that 135 gal. is removed from the sump every time the pump is operated. By using this figure as a constant and multiplying by the register reading, the total returns in gallons are easily computed for comparison with the amount of water delivered to the heating system.

Temperature of the Outside Surface of a Steam Pipe

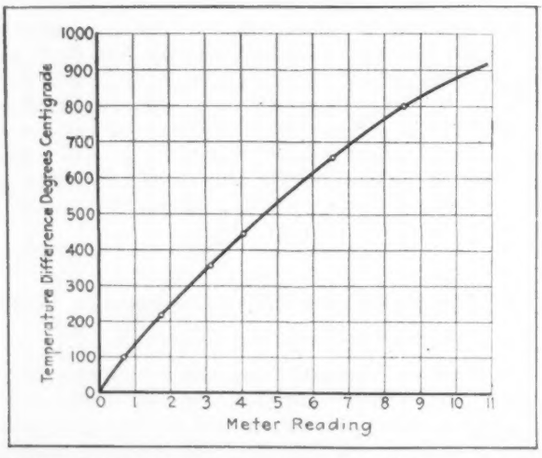
Results of temperature measurements by Henry Kreisinger and J. F. Barkley, reported in Technical Paper 114 issued by the Bureau of Mines, show that the temperature of the outside surface of a steam pipe is very nearly that of the steam in the pipe, and that there is no appreciable difference in the temperature of the outside surface whether the pipe is bare or covered with a 1-in. layer of magnesia pipe covering. Therefore the conductivity of the iron in the pipe is so high that only a fraction of a degree of temperature drop between the two surfaces is needed to conduct through the metal all the heat that can be radiated from the outside surface of the pipe under almost any condition. Also, the rate of heat impartation from the steam to the inside surface of the pipe is so high that the metal is kept at the same temperature as the steam. This is undoubtedly due to the fact that saturated steam can give off a larger quantity of heat by condensation without any change in temperature.

From the preceding deductions it follows that in computing the heat loss through pipe coverings the resistance to the heat flow through the metal of the pipe can be dropped out of the question and only the resistance of the covering material considered. That is, it is safe to assume the inside surface of the covering to be at the same temperature as the steam. These deductions hold true only for saturated steam. With superheated steam and hot water, both of which give off heat by a drop in temperature, the results would be greatly modified.

Convenient Recording Instrument for Thermocouple

BY ALLEN R. GREENLEAF

For carrying out investigations involving the measurement of temperatures with a thermocouple, an ordinary external-shunt type of ammeter used without the shunt makes a very convenient and satisfactory substitute for the potentiometer. Owing to the fact that the instrument consumes a small amount of power, the readings are slightly inaccurate because of fluctuations in room temperature and the consequent change in the resistance of the leads. When using leads of No. 18 copper wire, this error is calculated to be less than 1 deg. for a change of 20 deg. in room temperature, which is sufficiently accurate for most purposes. The instrument is calibrated by taking measurements on substances whose freezing or boiling point is known. A calibration curve of such an instrument as used by the writer is shown in the accompanying illustration. The thermocouple was made of copper and "ideal" wires, and the meter was a standard Weston 15-amp. meter used without the shunt. The readings follow:



TEMPERATURE CALIBRATION CURVE FOR 15-AMP. AMMETER

Calibration Point	Deg. C.	Reading
Boiling point of water	100	0.71
Boiling point of naphthalene	218	1.73
Boiling point of mercury	357	3.13
Boiling point of sulphur	444	4.09
Melting point of aluminum	657	6.58
Melting point of sodium chloride	800	8.55

Fuel and Lubricating Oil Consumption of Four Western Diesel-Engine Installations

While repairing gates to its water-turbine-driven generators, the city of Granite Falls, Minn., had occasion to maintain electric service by operating a 170-hp. Diesel oil engine continuously for slightly over 1000 hours. During that time $3.50 worth of crude oil and 46 cents' worth of lubricating oil were employed every twenty-four hours on the average. According to information given by the plant operator, the maintenance expenses have been very small and the engine has operated satisfactorily even under the severe tests of throwing heavy loads suddenly on the unit.

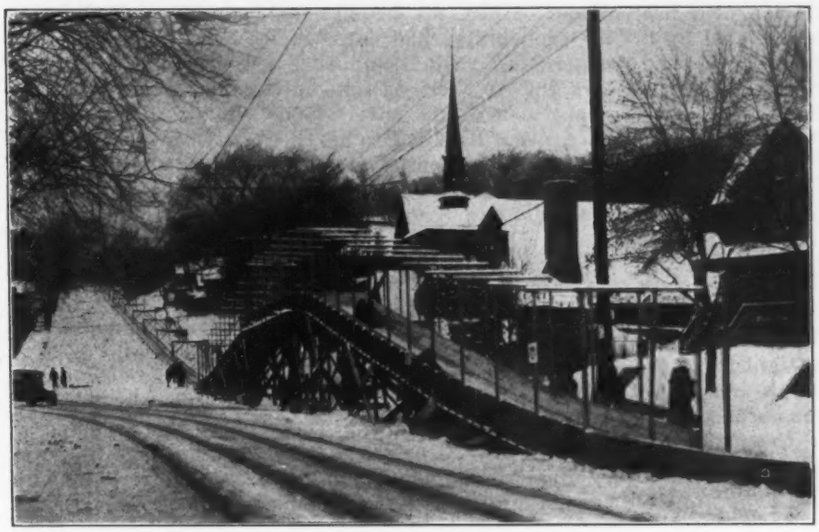
At Thief River Falls, Minn., where fuel oil costs 6.5 cents a gallon delivered, about 10 kw.-hr. of energy is being generated per gallon of oil with a Diesel oil engine operating between half and full load on the average. The upkeep for two 225-hp. units has not exceeded $25 a year according to the superintendent of the plant. He admits that the first cost of a Diesel engine is somewhat higher than that of a steam plant, but contends that it is compensated for by the smaller operating expense. The speed regulation, he adds, is fully as satisfactory as with a first-class steam engine.

Other information regarding Diesel-engine performance has been furnished from Estherville, Iowa. There 1280 kw.-hr. of energy has been generated with a consumption of 161.5 gal. of fuel oil costing 2.86 cents per gallon. This record covers a period of twenty-four hours, during which 22 pints of engine oil at 30 cents a gallon and 3 pints of compressor oil at 45 cents a gallon were used, making an expenditure of 4.38 mills per kilowatt-hour. This engine is also rated at 225 hp.

Formerly, when the same load was carried with steam engines, the fuel expense was about 1.5 cents per kilowatt-hour, and lubrication cost about 50 to 75 cents a day. Since the oil engine has been installed one boiler is banked all the time to supply steam for a fire whistle, the fuel for banking costing about $4 a day. In the winter during peak loads both the engine and steam equipment are required to carry the load. Eventually, however, another oil-engine-driven generator and an air compressor for blowing the whistle will be installed so that no steaming apparatus will be required. During six months' operation no money was expended for repairs to the oil-engine equipment. The engine was operated normally two weeks continuously, although it was once run twenty-six days continuously.

Records for the Menasha (Wis.) municipal plant are especially interesting because two of the four 600-hp. engines installed there have been in service ten years. With these engines 146,000,000 gal. of water has been pumped against 60-lb. pressure at a total expense, including power-house, distribution, office and depreciation charges, of $4,121.65. Electrical energy has been generated at good and poor load-factors for 4 mills to 6 mills per kilowatt-hour. Despite the age of two engines, repair bills have been less than $100 a year. For the four Diesel engines they did not exceed $50 in eighteen months.

Electricity at St. Paul's Carnival of Winter Sports—The 1800-Ft. Ramsey Street Slide Lighted by 900 Lamps



From Jan. 27 to Feb. 5 the people of St. Paul, Minn., held a great ten-day outdoor-sports carnival which attracted visitors from the whole Northwest. Curling, ski-ing, hockey, skating, tobogganing, spectacular fireworks, etc., with international prize contests, were numbered among the features of the celebration. On Harriet Island in the Mississippi River was built an ice fort, 10 ft. high, inclosing skating and hockey rinks, which were lighted by six 500-watt lamps. A 1000-watt lamp marked each corner of the fort itself, and red, green and white lamps, the carnival colors, were strung inside the wall facing the city, showing through the ice as one approached the fort. A 22-in. searchlamp on top of the Consumers' Power Company building was also played on the fort and served for flood-lighting. There was a toboggan slide on the island, and also three or four others in various parts of the city, all of which were electrically lighted. The Ramsey Street slide, 1800 ft. long, with its first 1100 ft. at 11 per cent grade, was lighted by 900 red, green and white 25-watt lamps. Two 1000-watt lamps mounted on top of a 70-ft. pole at the top of the ski jump lighted evening contests. Energy for lighting the slides and several centers of carnival activity was furnished gratis by the Consumers' Power Company and the St. Paul Gas Company.

MARKETING ELECTRICITY

A Department on Selling Service and Widening the Use of Electrical Energy

The Local Value of National Popular Advertising

Pointing Out to the Dealer that Results for Him Depend on What He Does to Apply It

BY ROLAND B. CHESTER

THE electrical manufacturer who advertises in the popular magazines does so for two reasons. The first is to increase his own prestige, which interests him alone; the second is to make sales of the line advertised, and this interests also the electrical dealer and the central station, since no sales to speak of are made to the consumer direct. Yet many in the electrical trade, while admitting the educational value of manufacturers' advertising, deny that these "ads" make sales for them, and contend—and they have figures to prove it—that the "ads" bring no customers into their stores.

THE SOURCE OF THE TROUBLE

The manufacturer himself is largely responsible for the existence of this state of affairs, for he has overlooked the importance of local application and utilization. Persuaded that advertising is a good thing, he lays out a campaign, calls his salesmen together, and gives to each a set of proofs. "Now, boys," he says, "we are going to spend a mint of money advertising our goods in the national magazines. Look at the proofs of these 'ads.' They will reach 5,000,000 people and will create a big demand. The dealers' stores will be filled with customers insisting on our goods, so tell your trade to stock up and be ready for the rush." And the first time a dealer hears this kind of talk he "falls for it." "Good!" says he. "Here is a line that is going to sell itself. All I have to do is to put it on my shelves and hand it out to the clamoring public. Give me a lot of it." So he puts in his stock, watches the "ads" appear, and waits for the rush. But the rush fails to materialize, and when the next salesman comes in with a similar story he finds that this dealer has become a skeptic.

In the meantime our amateur advertising manufacturer is counting up the concrete returns from his initial effort in popular advertising. He has received 850 inquiries and is happy, for these 850 inquiries stacked up on top of his desk make quite an impressive pile. So he decides to send these inquiries to the trade to demonstrate conclusively the extent of the demand. But when he begins to figure he finds that he has just about one inquiry for every twenty dealers, which is hardly a sufficient showing to stampede the trade; and further investigation demonstrates that of these a large proportion come from people who have no intention or no ability to buy. Finally, when he learns that the dealers were not visibly affected by prompt and profitable purchases from the readers of his "ads," he likewise may come to the unfortunate conclusion that such advertising is a disappointing delusion and cancel the rest of his contracts. And naturally such action is not calculated further to increase the trade's enthusiasm toward advertising.

There is evidently something wrong with campaigns that wind up in this manner because the power of popular advertising to make money for both manufacturer and dealer is proved and undeniable. The trouble lies in misunderstanding exactly what advertising does do and how to "cash in" on it. And the unfortunate phrase, "create a demand," is mainly responsible for this understanding, for popular advertising will *not* create a positive demand for electric appliances and accessories as things are at present, regardless of what it will do for other and better understood lines.

TRACING THE ACTION OF THE "AD"

To determine just what this kind of advertising does do, let us consider the case of Mrs. John Smith, who is reading her magazine at leisure, after a hard day's work in the kitchen or on the club committee, as the

case may be. As she turns the pages her eye is caught by an advertisement of an electric iron, coffee pot, vacuum cleaner, or what not. This advertisement has been prepared by a skillful copy-writer, assisted by a talented artist. It is no mere description of a dead piece of metal, but a story from her own life, picturing her own problems and pointing out how the device advertised can help solve them. It is a work of art and grips her attention and interest.

"That's fine!" she says to herself. "I'd like to have one of those." A desire has been created within her. But as a direct reaction what can she do to satisfy this desire? Nothing. The manufacturer is the only "point of contact," and he is hundreds of miles away and means nothing to her anyhow. She can write to him, of course, but that requires an unusual kind of effort, and she is tired. Besides Esmeralda was in a tight fix when she turned the page, and so she goes back to her reading, and the incident is ended as far as she is concerned. Of course, a few persons will write to the manufacturer and a few will hunt the stores until they find the article advertised. But the thousand or so that do these things—those that represent the actual "demand"—are negligible as compared to the 5,000,000 whom the advertisement actually spoke to and will not make a ripple in the trade. On the other hand, there are probably 400,000 or more actual prospective buyers who are in the position in which we left Mrs. Smith.

Here, then, we have no demand to speak of, but a vast inactive desire. How can we transform this desire into the kind of action we want, namely, the buying of the goods at a local store?

How to Make the Local Contact

Mrs. Smith has learned of the vacuum cleaner or iron, has wanted one, and has then forgotten about the matter because she could not act at the time she felt the desire. Now suppose she sees an advertisement in her newspaper, or gets a letter, stating that George Brown, electrical dealer, corner of Market and Main Streets, has this same device for sale. What happens? Her original desire, the result of the advertising man's art, comes back to her with a rush. This is inevitable —it is due to the association of ideas. But there is this difference from the original situation which we pictured. Now she can *act*. George Brown, the local merchant, represents something tangible to her. If he has advertised himself properly, she knows of him already; but in any case he can be reached by easy and, for her, quite natural methods—by telephone or personal call. As a result a number of these Mrs. Smiths will respond to the dealer's follow-up. Some, of course, will not, for even telephoning or calling represents more effort than the degree of desire they feel will stimulate. But when some of these women pass Brown's store and see these goods appealingly displayed in the window back comes again the whole set of associations, and it becomes now merely a matter of stepping into the store, and the sale is made.

The dealer, therefore, "cashes in" on the manufacturer's national publicity by following it up with his own advertising, by administering a local impulse that will make this general advertising react specifically for him in response to the local influence of his window displays, form letters, newspaper "ads" and other direct messages. Most manufacturers will assist him in this work by furnishing him with window-display material, newspaper cuts, good folders, street-car cards, billboard posters and the like, and will prepare the best of copy for his advertisements and letters. But, though dealers have been using these "dealers' helps" for years, too many fail to appreciate their special value in following up closely the manufacturers' national advertising. The important point is this, that good as these helps are when used alone they are vastly more effective when backed up by national advertising. For, in all probability, had Mrs. Smith not seen that magazine "ad," with its unusually skillful appeal directed straight to her as one of a class, Brown's announcements and letters and window display would have meant but little to her, because Brown cannot hope to spend long months and very large amounts of money in preparing each of his "ads," nor can he spread them broadcast throughout his territory.

Increasing Advertising Efficiency

Hence the manufacturer's and the dealer's advertising mutually increase each other's effectiveness. Neither alone can produce anything like the results that are possible to the two working together, in spite of the fact that many dealers are opposed to following up the manufacturer in this way, and especially to using his name in their "ads." They believe that in doing so they are losing their own individuality, that they are playing "second fiddle" to the manufacturer, and are committing themselves to handle his goods forever. Yet none of these propositions can be seriously maintained for a minute; for, on the contrary, by following up the manufacturer they are merely taking advantage of an excellent opportunity to make money.

The manufacturers who hope to win a national popular recognition and demand must bring this point home to the dealer forcibly and establish a mutual understanding and a practical co-ordination in these efforts of publicity that will effect a more efficient utilization of the money spent and the broadcast "desire" that now so often lies inactive. The dealer must appreciate that in the main the local benefits depend on his ability and willingness to do his part. There must be a closer contact between the manufacturer and the man who sells in the work of reaching those who read the popular advertisements.

How to Make a Small Show Window Large

The office occupied by the Massillon (Ohio) Electric & Gas Company is narrow, and consequently the show windows are not so large as might be desired. Nevertheless, the company's new-business department has found a way of enlarging the display space to generous proportions. As shown in the photograph herewith, a rounded platform at the same level as the show window has been extended back into the office. Now, instead of a 2.5-ft. by 6-ft. show window, the company has approximately a 6-ft. by 12-ft. display space for its appliances. The interior platform has a further advantage in that it allows appliances to be placed where customers paying bills cannot fail to see them and can inspect them closely if they desire.

A COMBINATION INTERIOR-EXTERIOR SHOW WINDOW AT MASSILLON, OHIO

Demonstrating Electric Ranges on the "Prospect's" Own Back Porch

An interesting electric-range campaign about to be started in California will be operated along lines which certain coal-range manufacturers have used with telling effect in the past. The Federal Sign System (Electric) of San Francisco, as a representative of the Globe Stove & Range Company, Kokomo, Ind., is making arrangements with the Pacific Coast power companies to conduct the campaign among the power companies' customers. A Globe range will be mounted on a motor truck carrying meters graduated in "cents" and "cents per hour," and the truck will move from house to house, giving complete cooking demonstrations on the back porch of each prospective customer. The range will be connected to the company lines outside of the household meter so that the trial will cost the customer nothing.

New Area Rate to Encourage Electric Cooking at Waterbury, Conn.

The United Electric Light & Water Company has just put into effect in the cities of Waterbury and New Britain, Conn., a new rate for residence service, the elements of which are as follows:

	Per kw.-hr.
For any part of the first 1.2 kw.-hr. per month, per 100 sq. ft. (or fraction thereof) of floor area	10 cents
For any part of the next 2.8 kw.-hr. per month, per 100 sq. ft. (or fraction thereof) of floor area	5 cents
For all in excess of 4.11 kw.-hr. per month, per 100 sq. ft. (or fraction thereof) of floor area	3 cents

Minimum area, 800 sq. ft.; minimum bill, 50 cents per month.

This rate is designed to encourage and to permit the use of electric ranges and other electric-heating and labor-saving devices in the household, without the necessity of installing two meters, and has been so designed that additional energy used in this way will cost about 3 cents per kilowatt-hour.

The company has also announced a new commercial lighting rate as follows:

	Per kw.-hr.
For any part of the first fifty hours' use per month of the demand	10 cents
For all above fifty hours' use per month of the demand	5 cents

Minimum demand, 200 watts. Minimum bill, 50 cents per month.

A Telephone Canvass at Pittsfield, Mass., and Its Results

H. W. Derry, contract agent for the Pittsfield (Mass.) Electric Company, reports some interesting figures on a canvass of 312 telephone subscribers recently made by telephone in that city for the purpose of securing data on the number of unwired houses among people sufficiently well-to-do to afford telephones and therefore presumably good "prospects" for electric light.

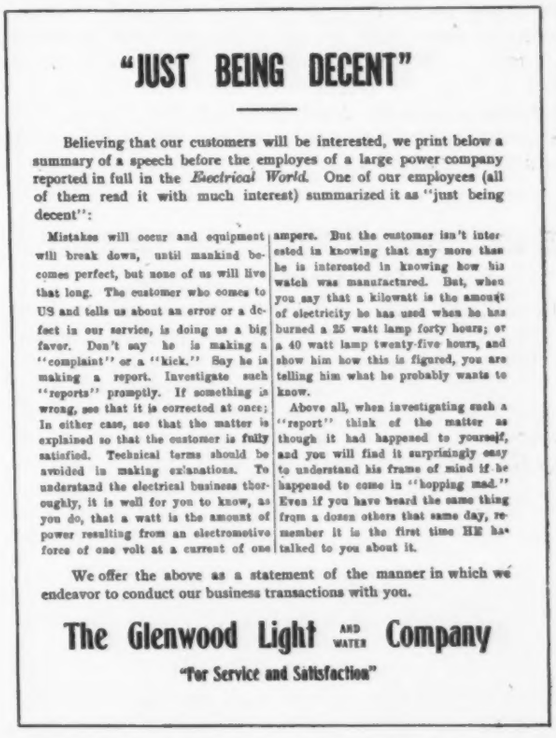
In all, 312 numbers were called up, from fifty-three of which, for various reasons, no returns could be secured, owing to all the members of the family being out or some similar reason. That left a remainder of 259 houses, and of these 154 proved to be unwired. Naturally, in these telephone talks the company's representative endeavored to develop further information, and he attempted to sell a night-lamp unit where possible. Of the 105 customers in wired houses, eleven said they already were using night lamps, eight requested that they be sent on approval, and two gave purchase orders. In twenty-nine cases they said that they would consult another member of the family and telephone if the lamp was wanted, while fifteen said that they would call and see it and nine just promised to consider. Among the unwired houses talked to, sixteen made requests that a salesman be sent to discuss the wiring of their homes, while in fifteen cases it was found that while the house was wired and equipped for electric lighting, it was not connected to the lines.

This canvass was spread over the month of January, so that the telephoning might be done with ease at odd times, and Mr. Derry feels well satisfied with the amount of material it has developed. It consumed far less time than would have been required for an equal number of personal visits to these houses.

Winning Public Confidence at Glenwood Springs, Col.

BY H. G. OVERBECK
General Manager Glenwood Light & Water Company

On the last Saturday of each month the Glenwood Light & Water Company of Glenwood Springs, Col., publishes in its advertising space in the Glenwood weekly paper a talk on company policy and local electric service. This plan was suggested by an editorial in the ELECTRICAL WORLD some months ago on the subject of taking the public into the central station's confidence on matters of company policy.



"JUST BEING DECENT"

Believing that our customers will be interested, we print below a summary of a speech before the employes of a large power company reported in full in the *Electrical World*. One of our employees (all of them read it with much interest) summarized it as "just being decent":

Mistakes will occur and equipment will break down, until mankind becomes perfect, but none of us will live that long. The customer who comes to US and tells us about an error or a defect in our service, is doing us a big favor. Don't say he is making a "complaint" or a "kick." Say he is making a report. Investigate such "reports" promptly. If something is wrong, see that it is corrected at once; in either case, see that the matter is explained so that the customer is fully satisfied. Technical terms should be avoided in making explanations. To understand the electrical business thoroughly, it is well for you to know, as you do, that a watt is the amount of power resulting from an electromotive force of one volt at a current of one ampere. But the customer isn't interested in knowing that any more than he is interested in knowing how his watch was manufactured. But, when you say that a kilowatt is the amount of electricity he has used when he has burned a 25 watt lamp forty hours; or a 40 watt lamp twenty-five hours, and show him how this is figured, you are telling him what he probably wants to know.

Above all, when investigating such a "report" think of the matter as though it had happened to yourself, and you will find it surprisingly easy to understand his frame of mind if he happened to come in "hopping mad." Even if you have heard the same thing from a dozen others that same day, remember it is the first time HE has talked to you about it.

We offer the above as a statement of the manner in which we endeavor to conduct our business transactions with you.

The Glenwood Light AND WATER Company

"For Service and Satisfaction"

A FRIENDLY TALK WITH THE CENTRAL-STATION CUSTOMER AT GLENWOOD SPRINGS, COL.

These present series of advertisements, one of which appears each month, are afterward reprinted on slips and these are inclosed with the monthly statements sent out to customers. A New Year's greeting was the first in the series, which is planned to run throughout the year.

The second advertisement, "Just Being Decent," reproduced herewith, went out with the bills of Jan. 31. This latter material, by the way, is a rather free summarizing of the excellent article on "Killing Complaints with Courtesy" in the ELECTRICAL WORLD of Jan. 8. In general, the advertisements are being so shaped as to lay special stress on the subject of service, and through persistence the company hopes to get its point of view before the community.

Broadening the Friendly Contact

The humanness of a public-utility corporation—that quality so doubtful in the public mind a few short years ago—is coming into growing prominence these days, induced by the practice of those thoughtful, friendly courtesies that come so naturally between individuals. A good example is presented in the New Year's greeting sent this year to all users of electric energy in the city of Omaha, Neb., by Gen. George H. Harries, president of the Omaha Electric Light & Power Company. It read:

> "Pledged to the hearty co-operation in all movements which promise to make Omaha better, bigger and more prosperous, the Omaha Electric Light & Power Company wishes you a Happy and Useful New Year.
> "January 1, 1916."

This graceful act of good will met response in kind. It was an evidence of personality, of human contact that made the householder feel far more sympathetic toward the corporation that sells him light.

Every central-station general manager should put a memorandum in his "tickler" now to send appropriate greetings next year to all customers and prospective customers. In the meantime he can strive in other ways to build up friendly contact with his public and establish a broader reputation for the human side of his great enterprise and a wider circle of acquaintances as well as friends.

Electric Broilers Supplement Gas Stoves in Apartment Kitchens

In contrast with gas-heated broilers, which are likely to shrivel and to taint meats, the electric broiler has the distinct advantage of requiring no air and giving off no fumes, hence an electric broiling element may be operated in an air-tight compartment, insuring the preservation of the juice and moisture of the meat.

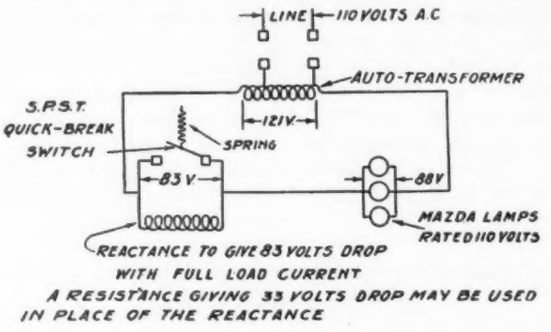
In the kitchens of a number of high-class apartments at Seventy-eighth Street and West End Avenue, New York City, which rent for $5,000 per year, electric broiler elements have been provided to supplement the

ELECTRIC BROILER IN KITCHEN OF NEW YORK APARTMENT

usual gas-range equipment. These Buzzini broilers take 20 amp. at 115 volts and consume from 10 kw.-hr. to 118 kw.-hr. per month, depending upon the menu. At the 8-cent rate of the United Electric Light & Power Company, the income from such broilers has averaged $4 monthly, while the lighting of the apartments ranges from $12 to $16 a month.

Operating Gas-Filled Lamps at Over-Voltage in Photographic Work

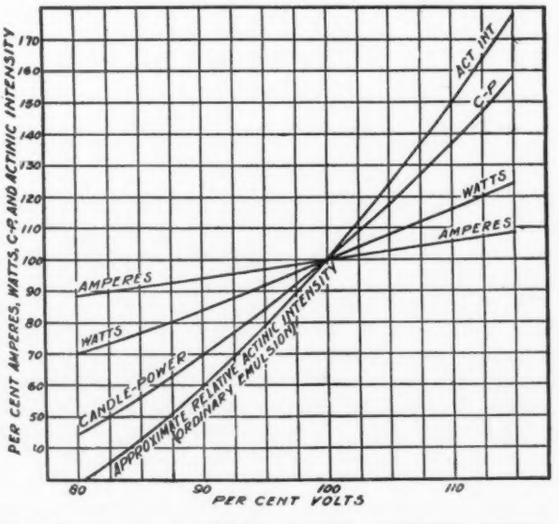
As shown by the accompanying performance curves for gas-filled tungsten lamps, the candle-power and the actinic intensity of the light increase much faster than the power demand when the voltage across a given lamp is increased above the normal operating pressure. For instance, with a 10 per cent increase in voltage above


LINE
110 VOLTS A.C
AUTO-TRANSFORMER
S.P.S.T. QUICK-BREAK SWITCH
SPRING
121 V
83 V
88 V
MAZDA LAMPS RATED 110 VOLTS
REACTANCE TO GIVE 83 VOLTS DROP WITH FULL LOAD CURRENT
A RESISTANCE GIVING 33 VOLTS DROP MAY BE USED IN PLACE OF THE REACTANCE

CIRCUIT FOR "FLASHING" PHOTOGRAPHER'S LAMP AT OVER-VOLTAGE WHILE EXPOSURE IS BEING MADE

the rated value, the actinic intensity increases 50 per cent.

Obviously continuous operation at such an over-voltage would decrease the lamp's life from 1000 hours to about 300 hours, but momentary over-voltage operation may not be objectionable in portrait or motion-picture photography as the posing may be performed at reduced intensity and the lamp later flashed to 110 per cent of its rated voltage only at the time of film or plate exposure. Connections permitting operating lamps in this manner are shown herewith. In series with the lamps is a resistance or reactance (depending on whether direct current or alternating current is employed) which may be shunted by a switch. With the switch open the resistance (or reactance) reduces the voltage across the lamps. When the switch is



PERFORMANCE OF GAS-FILLED LAMPS, SHOWING EFFECT OF VOLTAGE ON CANDLE-POWER AND ACTINIC INTENSITY

closed, however, 110 per cent rated voltage is applied to the lamps.

The method described for controlling lamps was suggested by J. R. Colville of the National Lamp Works of the General Electric Company before a recent committee meeting in connection with the Ohio Electric Light Association.

ADVANCE IN TECHNICAL THEORY AND PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Electrical Oscillations from Mercury-Vapor Tubes

An Account of a Theoretical and Experimental Research Which Led to the Development of a Double-Cathode Mercury-Vapor Oscillator Suitable for Large Powers

THE natural instability and high sparking voltage of the mercury-vapor arc suggest the possibility of its application for the production of powerful high-frequency currents by the Thomson (or Duddell) method. Research was carried out in this direction by Benjamin Liebowitz under the direction of Prof. M. I. Pupin at Columbia University, and an account of this research is given by Mr. Liebowitz in a recent issue of the *Physical Review*.

From fundamental considerations it seemed possible that the successful utilization of the mercury-vapor arc in a Thomson (or Duddell) circuit might be solved by merely putting a sufficiently large, properly constructed inductance in series with the tube. But in all experiments made in this direction the efforts to generate steady oscillations failed. From an extended mathematical investigation of the subject it was concluded that three requirements should be fulfilled: First, the impressed emf. must be large, several thousand volts; second, the series resistance must be large (several henries) and must be constructed so as to act as a unit for the rapid fluctuations of current and voltage; third, in the oscillatory circuit the ratio of inductance to capacity should be as large as possible.

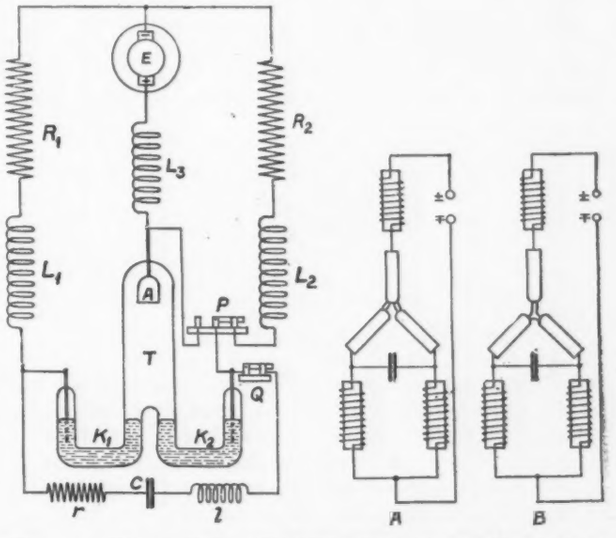
In the course of the subsequent experiments it was found that the third condition could be attained to a marked extent by the use of a double-cathode oscillator, two parallel discharges passing from two cathodes to a common anode.

The arrangement of the apparatus is shown diagrammatically in Fig. 1. A mercury vapor tube T is provided with two mercury cathodes K_1 and K_2 and an iron or graphite anode A. The cathodes are connected to the negative terminal of the high-voltage generator E through their respective inductances L_1 and L_2 and resistances R_1 and R_2. The anode is connected to the positive terminal of E through the inductance L_3. Between the cathodes is connected the oscillatory circuit consisting of inductance O, condenser C, resistance r and switch Q.

To facilitate the starting of the discharges, the switch P is provided, which, if thrown to the right, connects cathode K_2 to inductance L_2, and if thrown to the left, connects K_2 and anode A. When the switch is in the latter position K_2 is an anode; the discharge from cathode K_1 can therefore be started by tilting the tube in the usual manner. After this has been done, the switch P is thrown to the right and the tube is again tilted, which starts the discharge through K_2 without extinguishing that through K_1. During these initial operations the switch Q controlling the oscillatory circuit should be kept open. If the inductances L_1 and L_2 are sufficiently large, and if they have not too much distributed capacity, the parallel discharges between the two cathodes and the common anode are very stable. When the switch Q is closed the stability of the parallel discharges is destroyed, and, if necessary conditions are fulfilled, steady oscillations are obtained.

By preliminary heating of the tube and by increasing the inductance-to-capacity ratio to 10' or more, steady oscillations were finally obtained experimentally by this method. The frequency of the oscillations did not differ by more than 2 per cent from the natural frequency of the oscillatory circuit. Owing to its high sparking potential, the mercury-vapor tube would appear to be best adapted for large powers.

At first sight it would seem that the double-cathode method described is but a slight modification of the parallel-arc oscillator of Duddell and of Nasmyth. Further considerations show, however, that such is not the case. The most important difference between the two



FIGS. 1 AND 2—TWO ARRANGEMENTS OF DOUBLE-CATHODE MERCURY-VAPOR OSCILLATOR

oscillators lies in the fact that in the double-cathode method the oscillatory current passes directly between the cathodes, the anode carrying the direct-current discharge only, whereas in the parallel-arc method the oscillatory current must pass from the cathode to the anode of one arc and thence from the anode to the cathode of the other arc. For this reason the parallel-arc method seems to be suitable for Duddell oscillations only, but no such limitation applies to the double-cathode method.

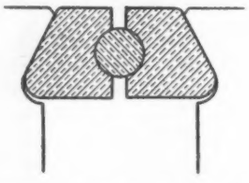
A further difference, which depends on the character of the arc itself rather than on the system of circuits in which the arc is used, was brought to light by some simple experiments. Three solid carbon rods, arranged as shown in Fig. 2, were connected through large inductances and suitable resistances to the 220-volt supply in such a way as to make one carbon an anode (or a cathode) and the other two cathodes (or anodes). Between the latter a large condenser was connected. By manipulating the carbons the arcs could be struck so as to start from separate positive craters and remain independent throughout their entire lengths, as shown in Fig. 2, *A;* or they could be

struck so as to start from a common positive crater and remain common throughout a considerable part of their lengths, as shown in Fig. 2, *B*. Case *A* is the parallel-arc method, case *B* is the double-cathode method. With about 4 amp. flowing through each arc a capacity of 10 mfd. was always more than sufficient to give violent oscillations in case *A*, whereas with the same current in case *B* a capacity of 50 mfd. at times gave no oscillations, at other times only weak ones, depending on the length of arc in common. We see, therefore, that merging two parallel carbon arcs for a considerable part of their lengths markedly decreases the instability, whereas in parallel mercury-vapor arcs the length of positive columns in common has no influence on the stability. This shows that in the carbon arc the seat of the instability is in the ionized column, while in the mercury-vapor arc the seat is at or near the cathode bright spot.

Attempts to apply the double-cathode method to other than the mercury-vapor and carbon arcs have not as yet been made. Such attempts would be worth while, perhaps, if only for the light which would be thrown on the seat of the instability in the various arcs.

Generators, Motors and Transformers

High-Speed Generators.—An account of the discussion which followed A. B. Field's paper on some difficulties in the design of high-speed generators. In the discussion which took place at Manchester F. A. Kuyser



WEDGE DESIGNED FOR HIGH-SPEED GENERATOR

described a system of ventilation which eliminates some of the objectionable features of axially ventilated machines. He exhibited a cross-sectional sketch of an 8000-kw., 2400-r.p.m. machine. Axial-vent chambers are provided in the usual way by means of holes punched in the core laminations. Nine radial ducts, each 0.75 in. wide, are provided instead of one central duct. Each axial duct is, therefore, divided into ten equal sections, the sections being connected together by means of a system of axial tubes which are welded to the ventilation spacers, the tubes serving at the same time to maintain the reqired distance between the punchings. At certain places the connecting tubes are left out and semi-circular distance pieces used, which allow the air to escape from the axial ducts to the radial ducts. The air outlets are evenly distributed over the whole length of the core, an equal number of axial ducts delivering to each radial duct. In addition to the elimination of the large central discharge, another advantage could be obtained by arranging the air streams to secure a counter flow action, the air streams in adjacent ducts having opposite directions of flow. This arrangement reduces the high temperature which occurs near the air outlet of axially ventilated machines and equalizes the temperature over the whole length of the core. Cramp approved the term "yield point" used by the author instead of "elastic limit" throughout the paper. Regarding ventilation he referred to the author's statement, "The system which lends itself best to the other features of the machine that we shall have to adopt is one combining an axial passage under the winding slots with a radial discharge distributed over a fairly wide central portion of the rotor." This is questioned by many designers, and it is thought that pure axial ventilation is very much better when it can be accomplished. The disadvantage of the three-part wedge is that the edges of the teeth are rather liable to damage when pushing the wedge into position. It also seems difficult to get the wedges to bed properly. The speaker submitted the drawing shown herewith as a good type of wedge. Miles Walker said one of the main features of the paper was the description of a rotor built up of thick steel plates, which, as pointed out by the author, is particularly suitable for very large outputs. When dealing with very high peripheral speeds—say, about 2400 r.p.m.—and large diameters, it becomes necessary to look round for some construction other than the solid type of rotor, which is very satisfactory for fairly large sizes. The speaker assumed that the author does not advocate a departure from the solid type in cases where it is definitely proved that good results can be obtained and where the stresses are not so high as required for the large machines run at very high speeds. An account of the discussion which took place at Leeds is also given.—London *Electrician*, Jan. 7, 1916.

Lamps and Lighting

Electric Lighting and Fire Statistics in Zurich.—A note giving a table prepared by a fire-insurance company of Zurich comparing for the ten years from 1905 to 1914 the number of fires caused by electric-lighting systems and non-electric-lighting systems. In these ten years 155 fires were caused by non-electric-lighting installation, the damage being $44,443, while only twenty-one fires were caused by electric-lighting installations, the damage being $4,116.—*La Revue Elec.*, Nov. 5, 1915.

Generation, Transmission and Distribution

French Water-Powers and the War.—MAX DU BOIS.—The author emphasizes the very important part which industrial development plays in the present war as an auxiliary to the armies. It is said that, in spite of the difficulties of developing low-fall water-powers, Germany utilizes almost one-third of its total water-powers while in France this ratio is not more than 10 or 15 per cent. The author emphasizes that France has to import coal and that any importation of coal in cases where water-power could be utilized means a loss of French capital to other countries. The author urges that the French government should be at the head of a movement to further develop French water-powers. Capital will be attracted automatically if a fair profit is assured and if the state does not want all the profit for itself.—*La Lumière Elec.*, Jan. 1, 1916.

Traction

Electrification of British Railway.—The first part of an illustrated article on the electrification of the Manchester to Bury section of the Lancashire & Yorkshire Railway. The length of the lines now being converted represents 22 miles of single track, but this is only the first stage. The third-rail direct-current system is used with a voltage of 1200. The power house contains two 5000-kw. turbo-alternator sets generating three-phase currents at 6600 volts. The article is to be continued.—London *Electrician*, Jan. 14, 1916.

Japanese Railway.—An illustrated description of the Usui-Toge mountain railway in Japan, which is partly operated by rack and pinion. Direct current at 650 volts is used with a third-rail. Three-phase currents are generated at 6000 volts and transformed to direct current in two substations. A storage battery is em-

ployed.—*A. E. G. Zeit.*, Vol. 16, Nos. 8 and 9, 1914; abstracted in *Elek. Zeit.*, Dec. 2, 1915.

Wires, Wiring and Conduits

Dielectric Losses in Cables.—M. HOECHSTAEDTER.—In single-conductor cables the dielectric loss increases with the square of the voltage, while in the multi-conductor cables the dielectric loss increases with a higher power of the voltage. In order to explain this discrepancy the author points out that the phenomena in the single-conductor cable must be considered as normal and that the different behavior of the same dielectric in the multi-conductor cable is due to the fact that the field of the electrostatic lines of force in the non-homogeneous cable cross-section is distorted under the influence of high voltage. Whenever the voltage rises above a certain critical value the insulation in the boundary surfaces between paper insulation and jute is burned. The author proposes a modification of the construction of multi-conductor cables.—*Elek. Zeit.*, Nov. 25, 1915.

Electrochemistry and Batteries

Cyanamide Works.—KURT PERLEWITZ.—An illustrated description of the calcium carbide and calcium cyanamide works in Odda, Norway. Current is supplied from the Tyssedal power plant. The carbide factory uses 37,500 kw. There are twelve old carbide furnaces, each of 1400 kva., with a daily production of 7 tons to 8 tons of carbide, and ten new furnaces, each of 3000 kva., with a production of 16 tons to 18 tons. The cyanamide works consume 57,000 tons of carbide a year and produce 80,000 tons of calcium cyanamide, the power consumed being 4500 kw.—*Elek. Zeit.*, Dec. 9, 1915.

Electric Laboratory Furnace.—D. F. CALHANE AND H. A. LAVENE.—An illustrated description of an electric laboratory furnace for carrying out reactions under pressure. Details of the construction are given and a calculation of the heat losses of the furnace is added.—*Met. and Chem. Engineering*, Feb. 1, 1916.

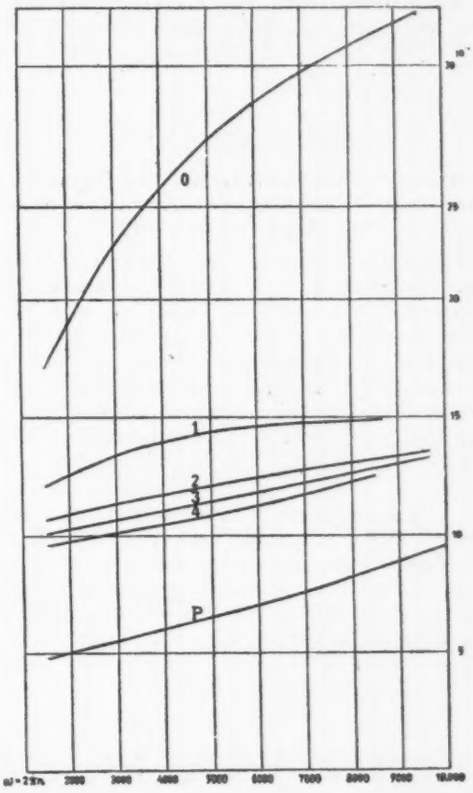
Units, Measurements and Instruments

Alternating-Current Measurements.—RICHARD HIECKE.—The author discusses the difficulty of alternating-current measurements and illustrates these difficulties by example of the measurement of the transformation ratio and the phase difference between primary and secondary of a measuring transformer. This phase difference is a very small angle. He shows that many difficulties can be overcome by making use of two emfs. which are displaced against each other by 90 deg., which are in a rigid ratio to the values to be measured, and which alternately supply the current for the fixed dynamometer coil. A source of two-phase or three-phase current is required.—*Elek. u. Masch.* (Vienna), Oct. 17, 1915.

Induction Meters.—H. W. L. BRÜCKMANN.—While in Ferraris or induction meters of modern design the voltage field should, speaking broadly, be in quadrature with the current field, this is not exactly true. The amount by which the phase angle differs from 90 deg. is called the "difference angle." Methods have been devised previously for measuring this difference angle, and an investigation of how it depends on voltage, load current and frequency has been made. In the present article the author describes a new method of determining the difference angle and applies it to two modern induction meters of German make. It is found that the difference angle also depends on the power-factor and in general decreases when the power-factor decreases. This fact is gratifying to the meter designer. The author thinks that the variations of the difference angle may be explained by the variations in the watt consumption of current and voltage coils, this watt consumption being due to hysteresis and eddy-current losses. He concludes that the error due to the difference angle may be reduced by proper selection of the iron used in the meter.—*Elek. u. Masch.* (Vienna), Nov. 14, 1915.

Telegraphy, Telephony and Signals

Telephone Cables.—E. F. PETRITSCH.—The author gives a review of the results obtained with different types of loaded cables in the Vienna telephone system. As in this system some mechanical difficulties were experienced in inserting Pupin induction coils in the cable, the Krarup system was also tried. In the latter system a uniform increase of inductance is obtained along the line by winding an iron wire around the conductor. The



RATIO OF ATTENUATION COEFFICIENT TO FREQUENCY

author first gives results obtained with a particular section of the cable containing seven double lines, the copper conductor having a diameter of 2 mm. in each case. One of these double lines was not loaded. Two of the double lines were loaded with Pupin coils, while in the four other double lines the Krarup system was used, these being wound with a single, double, triple and quadruple layer of soft iron wire respectively. The results are given in numerous tables and diagrams. Of particular interest is the relation between attenuation coefficient and frequency as illustrated in the diagram. Curve *O* refers to the unloaded line and shows how the attenuation coefficient rapidly increases with the frequency. A considerable smaller attenuation coefficient and a very much smaller increase of the same with the frequency was found with the Krarup system, the curves 1, 2, 3 and 4 referring to a single, double, triple and quadruple layer of iron wire. It will be seen that it is hardly worth while to use two, three or four layers of iron wires since a single layer is almost as efficient. The curve *P* refers to the Pupin system, which is the most efficient, giving the least attenuation coefficient.

An entirely different problem is that of connecting loaded cables in series with interurban overhead telephone lines. It was found that the Krarup system as used on the Vienna telephone system has certain advantages. The iron wire employed in this case has a diameter of 0.3 mm. If an ordinary overhead interurban line consisting of various sections with different characteristics is to be connected in series with a loaded cable, the Krarup system has the advantage over the Pupin system, but it is entirely different when Pupin coils can be inserted also in the overhead interurban line in such a way that the characteristic of the overhead line becomes approximately equal to that of the loaded cable. In this case the Pupin system gives the lowest attenuation. The author concludes that to make the best use of the Pupin system the whole network has to be pupinized. If loaded cables are connected to ordinary unloaded overhead lines, the Krarup system is quite suitable for loading the cable.—*Elek. u. Masch.* (Vienna), Sept. 12 and 19, 1915.

Miscellaneous

Baltic Engineering Congress.—An account of the proceedings of the Baltic Engineering Congress in Malmoe. W. Dahlgren spoke on electric heating of buildings but concluded that in general the cost of electric power is prohibitive. Th. Tisen described an electric heating device and Zadeck described the electric kitchen of the Siemens-Schuckert company. U. Fosberg dealt with bearing friction. E. Sylwan gave a review of hydroelectric plants in Sweden. In 1912 about 60 to 65 per cent of the kilowatts in electric-power plants in Sweden were hydroelectric, and it is estimated that about 80 per cent of the kilowatt-hours generated a year came from water-powers. The available water-powers of Sweden are estimated to have an aggregate rating of 4,600,000 kw., and it was expected that by the end of 1915 one-seventh of this would be utilized. A table is given of thirteen Swedish hydroelectric plants with an aggregate capacity of 225,100 kw., with statistical data concerning their equipment.—*Elek. Zeit.*, Dec. 2, 1915.

Book Reviews

ARITHMETIC OF ELECTRICITY. By T. O'Conor Sloane. New York: The Norman W. Henley Publishing Company. 160 pages. Price, $1.

The twenty-first edition of this little book, which has just come off the press, is all that it claims to be, namely, a practical treatise on electrical calculations of all kinds reduced to a series of rules, all of the simplest forms and involving only ordinary arithmetic. Each rule is illustrated with problems, all solved in detail, but little explanatory text is used. For an ordinary electrician who wants to know how to make calculations the book should be very valuable. The only drawback to such a volume is that nothing has been left to the student. Where there is a chance of doing a problem more than one way a rule is given for each way, resulting in a total of ninety-three rules. In the opinion of the reviewer, the solution of electrical problems is made too mechanical. The book is small, however, easily fitting a coat pocket, and will make a good reference book once it has been carefully studied. The volume contains a number of excellent practical tables.

MACHINE DESIGN. By Albert W. Smith. New York: John Wiley & Sons, Inc. 500 pages, 277 illus. Price, $3.

In the fourth edition of this book the authors have revised the text in such a way as to include results of recent investigations of machine elements and bring the work up to date as a college textbook. The book approaches the subject of design from a very practical viewpoint, taking up first a study of motion in mechanisms, then energy in machines and the proportioning of parts as dictated by stress. A little less than one-third of the book is devoted to material of this character, the remaining two-thirds taking up the problems involved in the actual design of particular machines and parts. No attempt is made to take up complicated mechanisms, but rather those parts of any machine whose proper construction is essential to efficient operation. Accordingly the discussion of the text is confined to such subjects as joints, bolts and screws, axles, shafts and spindles, journals, bearings and lubrication, couplings and clutches, ropes, belts and chains, flywheels and pulleys, gears and the like. There are many good illustrations and useful formulas throughout the text, which makes it more than a college textbook and places it among practical reference texts.

ARITHMETIC OF ALTERNATING CURRENTS. By Ellis H. Crapper. New York: The Macmillan Company. 208 pages, 45 illus. Price, 75 cents.

In 200 pages and 50 worked examples the author has explained and illustrated in a very clear and understandable way the laws of the magnetic and electric circuit. While the book has been designed as a companion to one which takes up the theory of alternating currents more completely, it will serve as well as a practical reference book for those who are not thoroughly familiar with alternating-current problems. The book bears a misleading name, for it is not so much an arithmetic as a brief treatise on alternating currents, taking up the mathematics involved in a simple manner. The ten chapters of the work take up the generation of alternating electromotive forces, inductance and capacity, and a study of resistance, inductance and capacity in parallel. The last part of the book, about one-third, is devoted to circuit problems and machines under the headings of polyphase power, static transformers, induction motors and transformation of currents.

Books Received

Examples in Magnetism. By Prof. F. E. Austin. Published by the author at Hanover, N. H. 90 pages, 27 illus. Price, $1.10.

Color and Its Applications. By M. Luckiesh. New York: D. Van Nostrand Company. 344 pages, 129 illus., 4 color plates. Price, $3.

Deutscher Kalender für Elektrotechniker. Edited by G. Dettmar. Munich and Berlin: R. Oldenbourg. 672 pages, 226 illus. Price, 3.50 marks.

The "Mechanical World" Pocket Diary and Year Book for 1916. Baltimore: The Norman, Remington Company. 332 pages, 87 illus. Price, 30 cents.

Electric Railway Engineering. By C. Francis Harding, assisted by Dressel D. Ewing. New York: McGraw-Hill Book Company, Inc. 416 pages, 190 illus. Price, $3.

Engineering as a Career. A series of papers by eminent engineers. Edited by F. H. Newell and C. E. Drayer. New York: D. Van Nostrand Company. 214 pages. Price, $1.

Experimental Wireless Stations—Their Theory, Design, Construction and Operation. By Philip E. Edelman. Published by the author, Minneapolis, Minn. 272 pages, 98 illus. Price, $1.50.

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R. T. LINCOLN

Robert Todd Lincoln, eldest son of Abraham Lincoln, the anniversary of whose birth is observed to-day, was for many years first vice-president of the Commonwealth Edison Company of Chicago, continuing in that position until his retirement several years ago. Mr. Lincoln was born at Springfield, Ill., Aug. 1, 1843, and attended Harvard Law School. He was Secretary of War during the administrations of Presidents Garfield and Arthur, and he served as Minister to Great Britain from 1889 to 1893. A distinguished lawyer, Mr. Lincoln was the head of the firm of Isham, Lincoln & Beale, attorneys for the Commonwealth Edison Company and associated interests. For many years he was also president of the Pullman Company. Mr. Lincoln recently retired from all active corporation and legal work and now resides at 1775 N Street, N. W., Washington, D. C.

Prof. George D. Shepardson is to be the guest of honor at a dinner this evening, tendered by his friends, associates and former students to mark the completion of his twenty-fifth year of continuous service as head of the department of electrical engineering of the University of Minnesota, Minneapolis. Dr. Shepardson is a graduate of Dennison University, later taking his doctor's degree at Cornell, where he was for a time instructor in physics. In 1887 he served as a member of the engineering staff of the Edison Electric Illuminating Company of Boston.

Louis H. Egan has resigned as general manager of the Kansas City (Mo.) Electric Light Company, effective upon the reorganization of the Kansas City Railway & Light Company, of which his father, John M. Egan, has just retired as president. The younger Mr. Egan went to Kansas City in 1900 as technical adviser to his father, having been previously engaged in central-station work with the Eastern Michigan Edison organization in the suburban territory near Detroit. Four years ago he was appointed general manager of the lighting company, and he has effected many important improvements in its operation. Meanwhile the number of meters has increased from 16,000 to 45,000. Mr. Egan now plans to take a few months' vacation.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

Emerson McMillin of New York City, president of the American Light & Traction Company, has given a second scholarship in the engineering department of the University of Detroit.

S. Mayehara, electrical engineer to the Japanese government, who is visiting the United States to study American transmission and distribution methods, will spend the next four months in the East inspecting installations in the Atlantic seaboard states. Mr. Mayehara's mail address will be in care of the Japanese consulate at New York. From New York he will go to England, to investigate British plant methods.

S. J. Dill, vice-president of the United Gas & Electric Engineering Corporation, was the guest of the department heads and employees of the New Orleans Railway & Light Company upon the occasion of his recent departure from New Orleans and was presented with a silver after-dinner coffee set of handsome design. D. D. Curran, president of the New Orleans company, made the speech of presentation. Mr. Dill's new headquarters will be in New York City.

H. M. MAXWELL

H. M. Maxwell, the retiring president of the Western Association of Electrical Inspectors, has held the position of chief inspector for the Ohio Inspection Bureau at Dayton for ten years. Mr. Maxwell, who was born and received his early education at Columbus, Ohio, spent two years in the school of electrical engineering at Ohio State University and finished his university education at Cornell, graduating with the class of 1905. Upon leaving school he was employed by the Jeffrey Manufacturing Company of Columbus, Ohio, and later by the Ohio Inspection Bureau at Columbus, after which he moved to Dayton to accept his present position.

E. H. MARTINDALE

E. H. Martindale, the chairman of the Cleveland Section of the American Institute of Electrical Engineers, has been appointed chairman of the committee in charge of arrangements for the annual Institute convention at Cleveland next June. Mr. Martindale is a graduate of the Case School of Applied Science. After experience with the Illinois Steel Company and the Commonwealth Edison Company, he joined the staff of the National Carbon Company at Cleveland. In 1910 charge of the company's brush-testing laboratory was given to him, and since 1912 he has been sales engineer for the company on carbon brushes. At present he is also chairman of the engineering division of the National Carbon Club. Mr. Martindale is the author of a number of original studies on the use of carbon brushes, including a recent paper presented before the A. I. E. E. He is a member of the Tau Beta Pi, and for the past two years has been a member of the industrial power committee of the A. I. E. E.

C. L. Brown, who was general manager of the Riverside Light & Power Company of Abilene, Tex., has been elected secretary-treasurer and manager of the United Telephone Company of Abilene.

F. G. Frost has returned to Houston, Tex., as superintendent of the Houston Power & Lighting Company, after spending eight months at Lancaster, Pa., as engineer for the Lancaster Electric Company.

John M. Egan has resigned as president of the Kansas City (Mo.) Railway & Light Company, upon the transfer of the properties to the Kansas City Railways. Mr. Egan, who is sixty-nine years of age, plans to spend the winter at Castle Hot Springs, Ark.

Obituary

Dennis J. Hern, former superintendent of street lighting at Boston, Mass., died at his residence in Allston, Mass., Feb. 7, at the age of sixty-one. He was an old-time telegrapher, was known from coast to coast, worked for two years with Thomas A. Edison and assisted Alexander Graham Bell in his first experiments with the telephone. He had been manager of various telegraph companies.

NEW APPARATUS AND APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Recent Improvements in Repulsion-Induction Motors

The features in a new line of repulsion-induction motors being brought out by the Peerless Electric Company of Warren, Ohio, may all be said to be improvements in mechanical design. But by incorporating these mechanical improvements in the motors greater electrical efficiency has been attained. The full line of motors, which comprises machines of every commercial speed and frequency and of all sizes from ⅛ hp. to 7½ hp. inclusive, has greater electrical efficiency, higher power-factor and less slip than are generally found in motors of the same class. Without sacrificing ruggedness and neatness in design the number of necessary parts has been reduced. In consequence the motor is somewhat lighter in weight than other similar motors of a corresponding rating. That the ratings of these motors are liberal, however, is evidenced by the very low temperature rise, which varies from 28 deg. C. to 48 deg. C., readings being taken by thermometers placed on the field windings.

Speaking specifically, improvements have been made in the commutator, the governor device, the short-circuiting device, the brush-holder and the oil-ring arrangement. Throughout the entire machine an effort has been made to lock mechanically each motor part, each nut and each screw securely in its place.

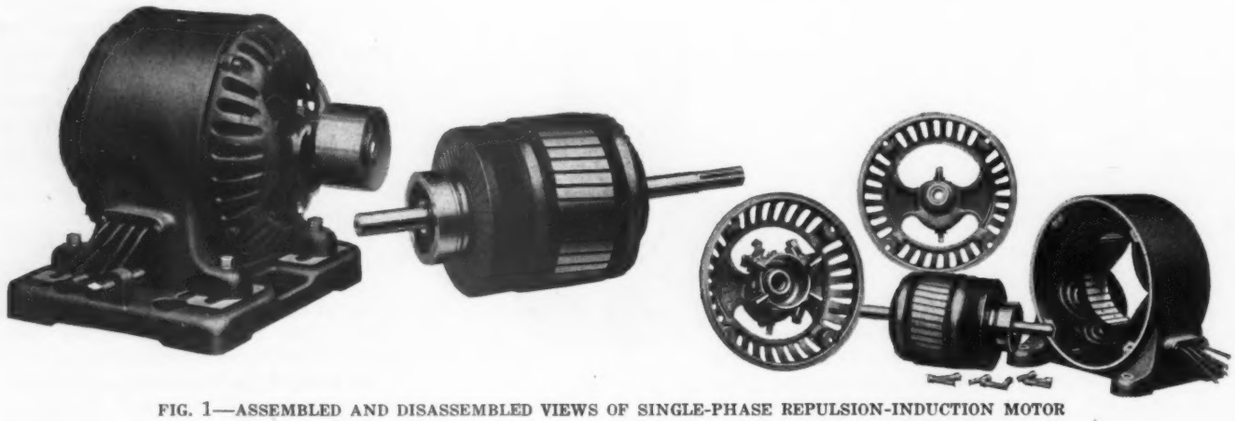


FIG. 1—ASSEMBLED AND DISASSEMBLED VIEWS OF SINGLE-PHASE REPULSION-INDUCTION MOTOR

In the commutator, which is of the vertical type, it was the aim of the designer to combine the advantages of absolute solidarity and accessibility with low factory production cost. Through the application of "bakelite" construction the company has been able to produce a type of commutator with fewer parts and less weight of copper than is usual. The company's methods of commutator construction are interesting and may be traced in detail from the accompanying drawing. Copper segments (42) for the commutator are punched from a formed copper bar, and from these punchings the copper part of the commutator is built up in the usual manner. With these copper parts laid face downward in a mold, a micanite ring (44) and a cast-iron cone flange (66) are placed in position on the back. Then bakelite in powdered form is placed in the annular recess on the back of the copper segments and up over the flange (66). Pressure and heat then applied to the bakelite causes it to set and form a binder (43) which rigidly supports the entire commutator structure. This method of construction has enabled the company to produce a commutator employing only one-half the copper ordinarily required without reducing the effective commutator copper. Less labor is also required in assembly. In the completed motor the commutator is attached to the front armature flange (27) after the windings are in place. A damaged commutator may therefore be removed without tearing down the entire armature structure.

The automatic governor which operates the commutator short-circuiting device (24) and the brush throw-off consists of only two parts, namely, the governor weight casting (50) and the stud (72) upon which it swings. The governor stud is mechanically locked in place by a special-punched washer (70), which, while it makes it impossible for the screw to work loose, is not an obstacle in the way of a workman wishing to disassemble the part.

The governor weight, which is carried inside the back flange (49), is designed so that its action is cumulative. This effect is produced by using an overhung projection on the free end of the governor weight. As the weight starts to swing outward the overhung portion adds greatly to the effective centrifugal force as soon as the center line of the motion has been passed. The quick and positive action of the weight thus produced is transmitted to the short-circuiting device and the brushes, so that their action is equally quick and positive.

Between the governor and the short-circuiting device connection is made by a flat-punched link (48), which contrary to usual practice is normally under tension. The change from normal compression to normal tension in this member, it has been found, eliminates troubles which sometimes exist owing to excessive friction produced by centrifugal force on these parts. This friction, of course, interfered to some extent with the prompt and proper action of the governor.

Short-circuiting of the commutator segments is ac-

complished by contacts (24), that "wipe" into position like circuit-breaker contacts and keep the contact surfaces clean. In detail the short-circuiting device consists of an assembled ring of special angular-faced punched copper segments. In the copper receptacle (23) that holds them these segments lie loosely but are still maintained in proper position. As these segments which form the short-circuit strike the angular face of the commutator a wiping and wedging action takes place, so that the contact surfaces are cleaned and the commutator short-circuiting segments adjust themselves to fit any slight irregularities on the angular commutator face. While the motor is in normal operation the segments are maintained in firm contact with the commutator face by the spring (20). The utility of this new short-circuiting device is evidenced by the better speed regulation it produces and by the increased ability of the motor to carry successfully heavy overloads without dropping out of step.

KEY TO REPULSION-INDUCTION MOTOR DRAWING

1. Hood screws.
2. Front hood.
3. Brush-holder gib screw.
4. Brush-holder gib.
5. Carbon brush.
6. Brush spring.
7. Oil drain plug.
8. Rocker arm.
9. Oil ring.
10. Bearing.
11. Bearing cap.
12. Shaft.
13. Bearing screw.
14. Oil plug.
15. Rocker-arm-adjusting screw.
16. Spring-barrel ring.
17. Thrust washer (back).
20. Short-circuit segment spring.
21. Spring-barrel ring nut.
22. Short-circuit weight shell.
23. Short-circuit ring.
24. Short-circuit weights.
25. Short-circuit weight wire.
26. Short-circuit weight-retaining washer.
27. Armature end plate (commutator end).
28. Field shell.
29. Field fiber.
30. Field core.
31. Armature fiber.
32. Armature core.
34. Locking key.
35. Field ring.
36. Back hood.
37. Pulley set screw.
38. Pulley.
39. Pulley key.
40. Adjusting nut.
42. Commutator segment.
43. Bakelite support.
44. Micanite ring.
46. Spring-barrel guide.
47. Governor spring.
48. Governor link.
49. Armature end plate (pulley end).
50. Governor weight.
51. Bell-crank pins.
53. Armature-core locking ring.
56. Commutator insulation.
61. Index plate.
62. Terminal block.
63. Leads.
66. Commutator flange.
69. Bell crank.
70. Governor pin-lock washer.
71. Governor pin-lock washer cotter.
72. Governor pin.
73. Knock-off finger rivet.
74. Brush throw-off finger rivet.
75. Finger spring.
76. Knock-off finger.
77. Brush throw-off finger.
78. Brush-spring cotter.
79. Brush clip.
80. Brush clip screw.

The rocker arm, which carries the carbon brushes (5), is a brass casting of rather rugged design. With the motor idle the brushes are normally held on the commutator face under strong pressure by a heavy bronze spring (6). Operation of the automatic governor throws the brushes sharply away from the commutator just after the commutator has been short-circuited. Since the finger (76) that slides inside the rocker-arm and operates the brush knock-off finger (77) moves toward the commutator, it is necessary to reverse the direction of its motion to make it lift the brushes. This reversal is accomplished in the following manner: The knock-off finger (76) engages both sides of the ring (16) that slides inside the rocker arm (8). When, through the action of the sliding ring (16), movement of the knock-off finger takes place, the lifting finger (77), actuated by the gear teeth hidden behind the small coiled spring (75), is moved in the opposite direction and lifts the brushes (5). In this mechanism there is a sort of toggle arrangement that tends, through the action of coil spring (75), to neutralize the tension of the brush spring (6) when the motor is in normal operation. The object of this arrangement is to prevent the knock-off finger (76) from pressing against the ring (16) while the motor is running, which would tend to cause noise and wearing of the finger. Adjustments to the brush-holder or its mechanism may be easily made, as the motor hood has only two arms in place of four.

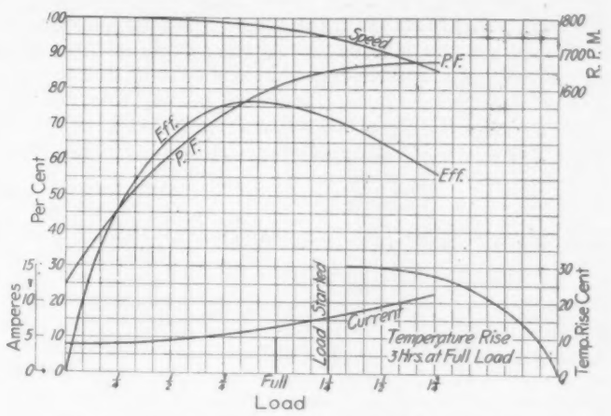


FIG. 3—TYPICAL CHARACTERISTIC CURVES OF MOTOR

The design of the hood is further unusual in that the oil rings (4) are not inserted through large slots in the

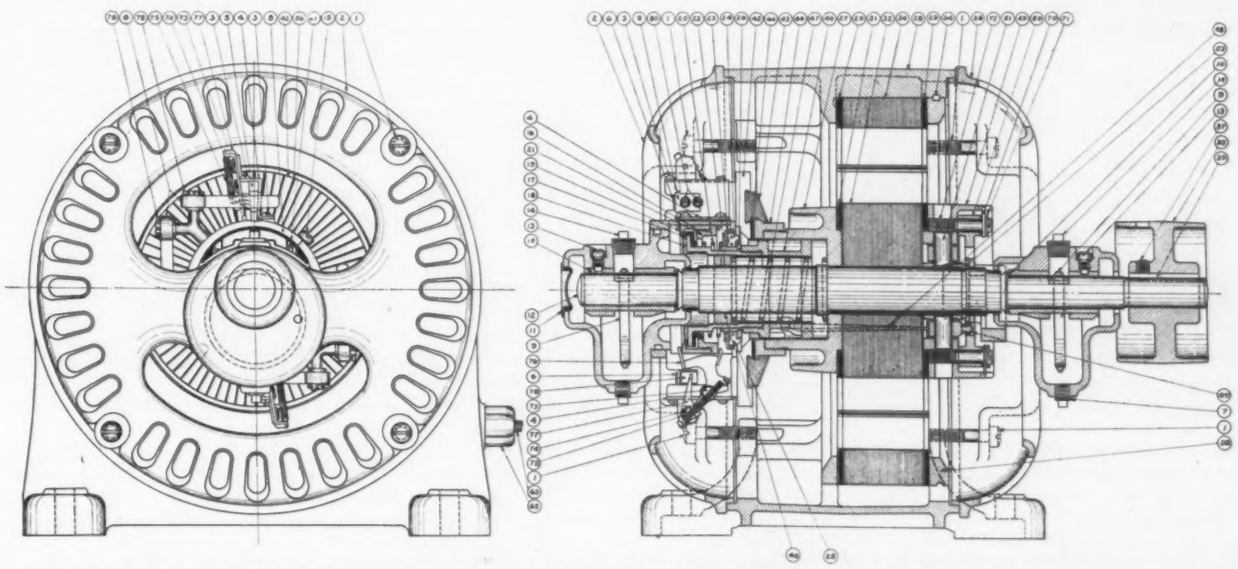


FIG 2—END ASSEMBLY VIEW AND VERTICAL TRANSVERSE SECTION OF IMPROVED TYPE OF REPULSION-INDUCTION MOTOR

bearing, but are molded in the foundry cores and cast inside the motor-bearing housing. This new arrangement eliminates the necessity of using a large hinged cover, prevents the ring from throwing oil from the bearing, and produces on the whole a neater housing.

Except in the smaller sizes, all motors in this line are wound for interchangeable service on either 110-volt or 220-volt mains. Otherwise arrangement of the electrical circuits does not differ from those of the ordinarly repulsion-induction motor. In spite of this fact, however, the manufacturer has stated that motors of this type, on account of improved mechanical design, require less starting current than any similar type now on the American market. The starting current ranges from two to three times full-load current. The motors also exert extremely high static torque; that is, the static torque is approximately 600 per cent of full-load torque. Typical characteristic curves which show speed, efficiency, power-factor, current and temperature rise over a wide range are given herewith.

Lineman's Shoe Made to Withstand 20,000 Volts

The Linemen Protector Company of Detroit, Mich., which for several years has been marketing protective shields to cover wires and cross-arms where men are working, has now developed an insulating shoe for electrical workers. Throughout their entire life a pair of these shoes, the manufacturer states, will provide the wearer protection against circuits at pressures up to 20,000 volts and will not cause the discomforts of many rubber shoes.

The shoes are molded by a process similar to that used in making automobile tires. The shoes contain no cement and have no seams, but are vulcanized into a solid piece under high pressure on aluminum molds. No hand work is employed in the process. This method of manufacture makes it impossible for the completed shoes to peel or come apart and prevents injury from oil, gasoline or grease.

In order that the shoes may, in the interest of safety, be distinctive, they are all made exactly alike with brown heels, white soles, brown vamps and black tops. The white soles are made of a rubber composition like that employed in certain types of coal miners' shoes which have been found to give eighteen months of constant wear. When this white sole wears through, a layer of red rubber, which will itself withstand a pressure of 20,000 volts, is exposed. The appearance of the red rubber is a signal or reminder to the wearer that, although his shoes still will withstand 20,000 volts, a new half

FIG. 1—NEW LINEMAN'S RUBBER SHOE FOR PROTECTION AGAINST 20,000 VOLTS

sole should be immediately cemented or vulcanized in place. The white rubber sole was selected for its wearing quality and not for its value as an insulator. At the toe this white rubber has been brought up over the end of the toe to cover the "stubbing point."

The brown rubber which may be seen at the vamp also extends under the white sole. It is this piece of material which is capable of withstanding high potentials. One of these shoes when tested in the laboratories of the Edison Electric Illuminating Company of Boston under the direction of the accident prevention committee of the National Electric Light Association showed the following characteristics:

"Side of shoe, dry, punctured at 31,500 volts, and again at 34,000 volts; sole of shoe between electrodes in oil punctured at 55,000 volts; 20,000 volts applied from salt water to salt water for one minute and 30,000 volts applied from salt water to salt water for forty-five seconds did not puncture the rubber."

FIG. 2—SECTION CUT DOWN THROUGH NEW-PROCESS LINEMAN'S SHOE

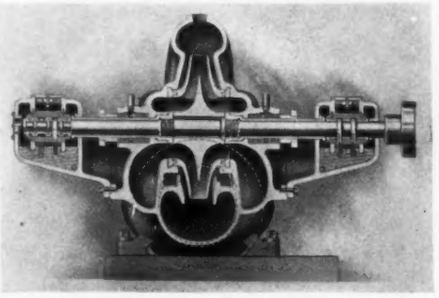
Before each shoe leaves the factory it is given a submerged test of 20,000 volts. All shoes which fail under this test are destroyed. The shoe is provided with a cushioned sole made of several layers of cork canvas and rubber. The shoe lining is pressed into the inner side of the rubber instead of being cemented to it, the idea being to produce as smooth and as durable an interior as possible. The top of the shoe is made of leather prepared by a patented mineral tanning process which at the same time waterproofs the leather and eliminates from it every trace of oil or grease. Tests made on this leather show that it is not affected by heat or by cold and that even boiling it in water will not make it crack or become hard. No metal is used in any part of the shoe.

A special stocking has been developed to go with the shoe, and this stocking, it is said, has solved the problem of preventing the perspiration of the feet which rubber boots and shoes ordinarily produce. The stocking is thick and heavy and is made of a combination of wool and cotton. It is woven with a smooth exterior and a rough interior. The outside has been made smooth so that the wear between the shoe and stocking will be reduced to a minimum. The inside has been made very rough so that, as it is worn over a man's ordinary sock, some free circulation of air will be permitted between the thick stocking and the sock. This circulating air prevents undue perspiration, and, the manufacturer states, assures the wearer warm feet in winter and cool feet in summer. The stockings are manufactured in but one size, but this size will fit any foot taking a shoe varying in size from No. 6 to No. 12. Because of the peculiar weave of the fabric the foot of the stocking can be pulled to fit the "No. 12" foot, or by pulling the top of the stocking after it has been placed on the foot it can be reduced in size for the "No. 6" foot.

Both the shoes and the stockings have been approved by the accident-prevention committee of the N. E. L. A.

Centrifugal Pumps

The Wheeler Condenser & Engineering Company of Carteret, N. J., is building a line of horizontal and vertical-shaft centrifugal pumps for general service as well as for condenser work. A small motor-driven unit for tank or standpipe operation shown in the illustration is equipped with a two-part divided casing, with the suction and discharge nozzles in the lower half. The impeller is of the closed double-suction type, protected by "labyrinth" wearing rings. The shaft is protected from the water by bronze sleeves, which screw onto the shaft and extend into the bearing bracket boxes. The bearings are of the ring-oiled type. In the outboard bracket there is a ring-oiled thrust bearing. A feature of these pumps, the manufacturer points out, is the large size of the bearing brackets and the fact that they are bolted to the pump casing, instead of being cast integral with them. The impellers are



SECTIONAL VIEW OF CENTRIFUGAL PUMP

cast in dry sand or skin dry molds, and the cores are made from a core "sand" which, being in reality a fine powder, when properly mixed and weathered and baked into a core, gives a surface to which the metal adheres perfectly. The result, it is claimed, is a finished impeller true to pattern.

Electric Automobile Brake

Included among recent automobile safety appliances is the electrically operated brake shown herewith, by means of which the car can be brought to an easy and almost instantaneous stop without the driver's removing his hand from the steering wheel. The

FIG. 1—CONTROLLER FOR OPERATING ELECTRIC BRAKE

brake is so designed that an automobile equipped with the device can be going at a speed of 50 miles per hour up to within about 35 ft. of a right-angle turn and yet reduce its speed so as to make the turn easily at 15 miles an hour. By means of this brake the car is slowed down gradually.

The complete outfit is compact and weighs only 35 lb. It consists essentially of a small reversible motor with a worm and worm wheel attached to a drum, to which is fastened a steel cable the other end of which is attached to the brake equalizer arm. Use is made of a special electric controller in reach of the driver's hand, as shown in Fig. 1. Two points are provided on the controller, one for making ordinary stops and the other for emergency stops. By pushing the switch back to its original position the brake is immediately disengaged. The motor of the outfit is of the high-speed series-wound type, and it can be operated by either a 6-volt, 12-volt or 24-volt storage battery. On the end of the armature shaft of the motor is a

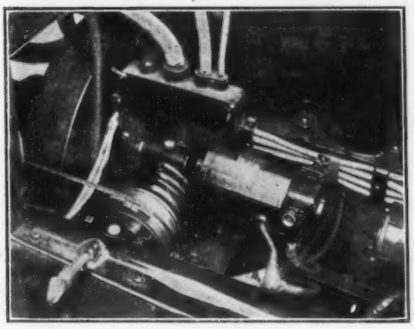


FIG. 2—MOTOR, BRAKE DRUM AND CABLE UNDER BONNET OF CAR

worm which drives a gear through a reduction of 100 to 1. This gear in turn operates a drum by an internal gear through a reduction of 4 to 1. A total reduction of 400 to 1 is therefore obtained. When running idle, the motor operates at 10,000 r.p.m., and when under load it can apply a pull of 1000 lb. at about the same speed as would be the case with a quick application of the hand emergency brake. After a pull of 1000 lb. is exerted on the cable a slipping clutch prevents any further pull and a ratchet prevents the brake from slipping off. Because of the powerful pull on the brake cable the brakes run in oil. The current taken in putting a 1000-lb. pull on the cable is 40 amp. for 0.4 second.

In Fig. 1 is shown a controller on the steering column of a Studebaker car, showing how the device can be operated by a single finger. In Fig. 2 is shown the reversible motor, brake drum and wire cable under the bonnet on a Studebaker car. The electric brake system is being made by the Hartford Suspension Company, 143 Morgan Street, Jersey City, N. J.

Multiple-Flaming-Arc Lamps

An entirely self-contained lighting unit of the flaming-arc type, designed especially for use in motion-picture studios and for engravers' service, giving a minimum production of light of

FIGS. 1 AND 2—FRONT AND BACK VIEWS OF STAND UNITS

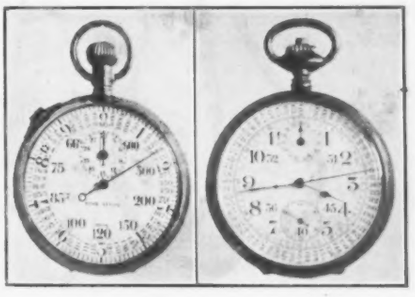
9100 cp. with a range upward that is, according to the manufacturer, the Scott Electrical Company, 357 Ogden Street, Newark, N. J., practically limitless, is shown herewith in two forms, one for lighting from the side and the other from overhead. The device is of the multiple-arc type, the fixtures shown in the accompanying illustrations being provided with two arcs. Increase in candle-power can be obtained by increasing the number of arcs. The mechanism of the lamp is very simple and feed is accomplished by gravity. A magnet is provided which when the circuit is closed pulls the electrodes apart; arcs are then formed which are 4 in. in length. One of the electrodes rests on the periphery of a small wheel, causing the upper electrodes to drop gradually as they are consumed. Use is made of a magnet dash-pot to prevent sudden movements of the electrodes. What resistance is utilized is in the form of an open bank of mi-chrome wires at the top of the unit and may be considered as part of it. It is not necessary, it is pointed out, to employ external resistance. The lamps designed for side lighting are mounted on telescopic standards so that the height of the fixture can be adjusted. Means are also provided for changing the angle at which the light is directed. These units are also equipped with

FIG. 3—LAMP FOR OVERHEAD LIGHTING

15-in.-square reflectors with reflecting surfaces finished in aluminum. The overhead units are provided with globes and 36-in. reflectors, as shown in Fig. 3, the mechanism being the same as that used with the stand lamp.

Time-Study Watches

Two types of time-study and motion-study watches which give direct readings in operations per hour, eliminating the necessity of mental or pencil calculation, and which are well adapted for use in testing electrical apparatus, where the time element is involved, are now being marketed by Mortimer J. Silberberg, 451 People's Gas Building, Chicago, Ill. Fig. 1 shows a time-study watch with its dial divided into tenths and hundredths of minutes and with figures, spaced two one-hundredths of a minute apart, which indicate at any point of elapsed time what is the corresponding output per hour. For instance, the watch as it stands in the illustration shows that the operation



FIGS. 1 AND 2—TIME STUDY WITHOUT AND WITH AN INTEGRAL TIMEPIECE

just timed required sixteen seconds, and by direct reading it can be seen that 375 such operations can be accomplished in an hour. When an operation requires more than one minute the fact is noted by the small hand on the interior dial. The watch is started and stopped by actuating the lever on the

edge of the case. Pushing the crown of the watch sets the hands back to zero.

The master chronograph, as the watch shown in Fig. 2 is called, has incorporated with the time-study watch a seventeen-jewel timepiece. Dial divisions for the timepiece hands alone are made in hours, minutes, seconds and fifths of seconds. Figures at the extreme outer edge of the dial indicate operations per hour for all operations requiring less than a minute. The number of operations per hour if a process requires more than a minute to reach completion may be read from the figure of the extreme inner circle on the dial, namely, 32, 36, 40, 45 and 51. Interpolation between these figures is so simple that more figures were not thought necessary. The master chronograph possesses all of the desirable features of the other time-study watch and, besides, relieves an observer of the necessity of carrying two watches.

Trouble-Detecting Device for Gasoline-Automobile Electric Systems

The "Ambu trouble-shooting" instrument, as it is called, shown herewith, is a device which is designed for use in connection with charts in locating trouble in gasoline-automobile electric outfits. The instrument is inclosed in a wooden case and is fitted with "universal-type" terminals so that it can be attached, it is declared, to any kind of automobile battery. In case of trouble it is connected to the battery line. Indicators point to numbers which the repair man looks up in the

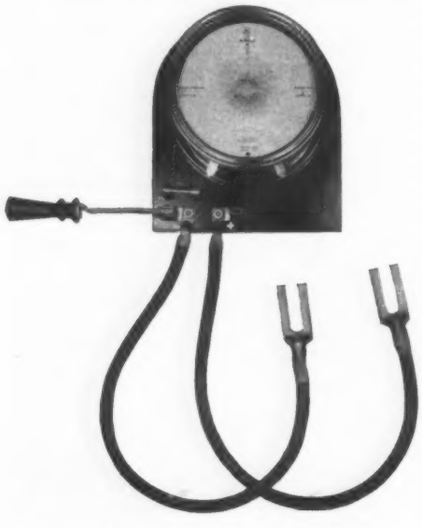


FIG. 1—TROUBLE DETECTOR FOR AUTOMOBILE ELECTRIC SYSTEM

charts where the location of the trouble, its cause and methods for remedying it are stated. Thus, the manufacturer points out, hours of searching through wire leads are avoided and the use of ammeters, voltmeters and other instruments is not required. The manufacturer states that there are some twenty-eight makers of starting and lighting equipment used on American cars who have produced more than fifty different types of installations. Each installation consists of from six to more than a score of separate units, and each of these units is subject to troubles in operation. The total number of possible faults, in a system of average design, it is estimated, runs to more than 250.

The "Ambu" device with its charts is designed for use in finding any of these many possible faults. The device is equipped with a glass-covered dial provided with three openings at the sides and bottom of the dials shown, through which appear certain numbers or the letter N, which are designated as "Engine idle; lamps off," "Engine idle; lamps on," and "Engine running; lamps off," respectively. Just above the surface of the dial is a pointer which moves according to the conditions in the electrical units. On the surface of the dial, extending from a point near the center to a point near

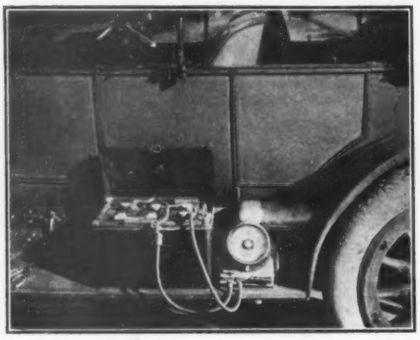
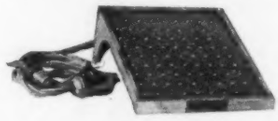


FIG. 2—TROUBLE-DETECTING INSTRUMENT CONNECTED TO AUTOMOBILE BATTERY

the outer edge, is a heavy line. Extending from the housing from below are three levers. After the instrument is fitted to the battery and the switch is placed in the position specified, the dial may be moved by moving the middle lever without moving the pointer. The lever may be manipulated to bring the heavy line on the surface of the dial directly under or back of the movable pointer in whatever position the pointer assumes. In testing a system the repair man first looks in the list of "key numbers" and finds the name of the car he is working with. After the name he finds the year and model or type of electrical equipment. One or more of these specifications serves to identify the car accurately. Opposite the name of the car he will find two numbers (printed thus, 12—7, etc.) which are the key numbers for that particular car. The repair man now takes hold of the left-hand lever and moves it one way or the other until the first key number is shown in the upper of the two upper openings of the dial. In the above-named case this number would be 12. He next moves the right-hand lever until the second number is shown in the lower of the two upper openings. Now, with the engine idle and lamps turned off, a number is shown in the lower opening; this number refers to the chart which states the trouble and how to rectify it. The instrument is being placed on the market by the American Bureau of Engineering, Inc., 1018 South Wabash Avenue, Chicago.

Electrically Heated Foot Warmer

An attractively finished electric foot warmer has been developed by the International Electric Company, Indianapolis, Ind., for use especially in elec-



ELECTRIC FOOT WARMER

tric pleasure cars. It may be also employed for heating small bathrooms, motion-picture booths, or wherever desired as an ordinary foot-warming device. The warmer is made of heavy highly polished cast aluminum, and is equipped with an inclosed heating element. The energy consumption is said to be quite low, and it is declared that it will not noticeably decrease the mileage of an electric car. It is portable and, if desired, can be heated from a lamp socket immediately before using in a car when a small amount of additional energy will be sufficient to keep the device warm and heat the car.

Spark-Plug Tester

A simple and convenient device for testing spark plugs on automobiles, motorboats, motorcycles, etc., is being placed on the market by the Pittsburgh Electric Specialties Company, Pittsburgh, Pa. The "Royal" tester, as it is called, includes a crotch containing the spark-gap. When the plug is in good condition the tester shows a spark of the correct proportion. If the plug is short-circuited, no spark will be shown. If the porcelain is defective, the tester will show an irregular spark. If the motor has no power, the tester will show a clear spark, indicating that

POCKET-SIZE SPARK-PLUG TESTING DEVICE

the trouble is in the mixture. If there is a knock in the motor, the tester will magnify the knocking noise, and by that means the trouble can be located in the cylinder in which it occurs. The device is of hard rubber with rounded corners. It measures 5 in. long and is convenient to carry in the pocket.

NEWS OF THE INDUSTRY

A Review of Activities in the Electrical Manufacturing, Selling and Central-Station Fields

United States Chamber of Commerce Convention

Committee on Maintenance of Resale Prices Unable to Agree and Report Will Be Submitted to Referendum

The fourth annual convention of the Chamber of Commerce of the United States took place in Washington Feb. 8, 9 and 10, President Wilson addressing the convention at the banquet of the organization on the night of the 10th. Advocacy of a tariff commission was one of the principal features of the convention, although much of the work dealt with questions of foreign trade. The concluding session of the convention was given over to a discussion of increased military preparedness and the subject of national defense, speakers taking the point of view that it is quite as necessary for the United States to be industrially prepared as to be prepared in a military sense.

Among the projects offered for the indorsement of the convention were:

A proposal from the Cincinnati Chamber of Commerce that "the Federal Reserve act, which now authorizes national banks to make bankers' acceptances based on export and import trade, be amended to authorize national banks to make such acceptances based on domestic trade and transactions."

A proposal from the Providence Chamber of Commerce to ask Congress to adopt a uniform national incorporation law because of "the enormous development of the foreign trade of the United States, which is creating problems and complications increasingly difficult of solution because of the indefinite status of corporations engaged therein, due to the wide diversity of laws."

A petition from the Pittsburgh Chamber of Commerce that Congress pass a new tariff schedule "tending upward," especially to cover goods manufactured and accumulated during the war by belligerent countries.

A "move toward industrial efficiency" from the Boston Chamber of Commerce, criticising the so-called "Deitrich amendment" to the army appropriation bill of 1915-1916, "which prohibited the making of time studies and the payment of premiums and bonuses to employees."

A proposal by the Philadelphia Bourse on the subject of the regulation of railroads, that the Interstate Commerce Commission be re-formed into district courts, one court for each freight traffic district, and that definite limits be placed upon the powers of the Interstate Commerce Commission along the lines of regulation of rates.

Opposition to government ownership of telegraph and telephone lines, from the Philadelphia Bourse.

A plan by the American Specialty Manufacturers' Association to amend federal laws dealing with unfair competition so as to permit independent and individual judicial recourse by those injured by unfair competition.

The National Chamber of Congress foreign relations committee recommended that an international trade commission be appointed by the United States government with power to investigate the chief foreign markets and to make recommendations as to commercial treaties to be negotiated with foreign countries.

Labor Exchanges

The committee on labor exchanges in its preliminary report merely suggests some of the questions it has before it for study. It says: "The technical side of industry has been organized in the United States with great success. Materials are selected with minute care according to chemical analysis. All the arts of engineering have been utilized to provide processes. Machinery which is daily more automatic has been devised to perform the processes and to deliver products of high quality. The part of industrial production which is represented by materials and by plant has been standardized to a point such that experts can readily draw the plans, state the specifications and erect the plants for new manufacturing businesses. Organization and standardization have by no means stopped at the factory but have extended with intensified vigor to distribution.

"To the human labor, however, which is the first requisite for the actual operation of any industrial organization too little attention in many respects has been given. In other departments costs have been figured to hundredths of a cent, but the cost due to shifting labor has been taken largely by guess, without much consideration of the gain or loss incident to having men fitted to the duties they perform, the loss accompanying the entrance of a strange man into new surroundings, or the loss which accrues when a man who is fitted to his job and knows it leaves his employment. The cost in these ways to an enterprise has been sensed in a general fashion by many managers, but very often it has not been specifically realized."

Maintenance of Resale Prices

The board of directors of the Chamber of Commerce of the United States have voted that the report of a special committee of the national chamber on the maintenance of resale prices shall be submitted to referendum. The committee had reported to the board that it was not able to present a unanimous report.

A majority recommendation favoring legislation permitting price maintenance was signed by seven members; two of them, however, modified their assent by filing a supplementary report. The committee is convinced that "legislation permitting the maintenance of resale prices, under proper restrictions, on identified merchandise, for voluntary purchase, made and sold under competitive conditions, would be to the best interest of the producer, the distributer and of the purchasing public, or consumer."

The supplementary report, signed by two members who also signed the majority report, recommended that injurious price cutting be included within the scope of the jurisdiction of the Federal Trade Commission over unfair methods of competition.

Three members of the committee presented a minority report "unable to approve of the principle of price maintenance as being in the public interest." They recommended, therefore, that no legislation on the subject be enacted at this time. The conclusions of the majority are that the advantages of price maintenance are partly economic and partly social. The minority

take the ground that the recommendation of the majority is directly contrary to the conclusions of federal and state courts on matters of principle. They dwell upon the importance of trade being "unhampered and unshackled by the requirements or commands of any men or combinations of men, or any systems whatsoever," and take the stand that legislation legalizing price maintenance will give rise to a situation such that it will become difficult for small merchants and men who seek to enter manufacturing to establish themselves.

Los Angeles Condemnation Testimony Concluded

All testimony before the California Railroad Commission in connection with the proper severance damages to be awarded the Southern California Edison Company for the condemnation of the Los Angeles system by the city has been concluded and the city allowed fifteen days from Jan. 26 in which to prepare and file its brief. The company is then allowed thirty days in which to prepare and file its brief, after which the city has ten days to file its brief in rebuttal, if so desired.

In the closing testimony C. W. Koiner, manager of the Pasadena municipal plant, and J. D. Ross, manager of the Seattle municipal plant, appeared in behalf of the city and substantiated the value of the physical property as previously given and in addition gave some interesting testimony regarding the effect of municipal competition upon private operation. The next witness called by the city was O. E. Clemens, cost accountant for the engineering department of the bureau of power and light, Department of Public Service. He presented a number of charts and diagrams showing the relationship between the Edison company's business within the city of Los Angeles, both power and lighting, exclusive of railway power, and the business outside of the city of Los Angeles exclusive of railway power. These curves were designed to show that the outside business has been increasing at a faster ratio than the so-called "inside" business, also that the general average compound annual increase for the last eight or nine years has been somewhat better than 20 per cent, even after considering the slump during the years 1914 and 1915. The intent of these charts was to show the tendency of the development of the Edison company on the outside of the city. In addition to these charts, he introduced several calculations, among which were one showing the Edison company operating the railway power at a loss and also operating in the Pasadena district at a loss where it is in competition with the municipal plant. He showed that the Edison company would earn upon the present depreciated value of its property 7.64 per cent, and by adding to the return the additional return that would be received provided that the railway power and the Pasadena business were placed upon an 8 per cent basis the actual net returns to the Edison company after severance would be 8.55 per cent.

E. F. Scattergood, chief electrical engineer for the city, fixed total just compensation at $3,887,838. He also introduced a very comprehensive exhibit showing as the net results of severance that the generating plants of the company will upon recovery of peak be in a better position from an operating standpoint than at present, the basis for this calculation being the fact that the hydraulic power could be utilized more profitably. The peak loads obtaining in the outside districts along with the peaks of the smaller cities remaining to them balanced off the load so as to make this possible. On this account no consideration was given by him to the diversity-factor damage.

The summation of values as established in this hearing are as follows: The Edison company values estimate severance on account of operating losses at $10,706,236; going value, $4,713,999; physical property, $4,200,000; unamortized bond discount and expense pertaining to the Los Angeles system, $380,340, making a total of approximately $20,000,000. The city's claims were for a property value of $3,473,803 and idle plant compensation of $414,035, making a total of $3,887,838. The railroad commission engineers produced a value of $3,830,094 for the physical property, making no attempt to fixe or determine severance values.

Electric Light in the Home Subject of Prize-Winning Window Display

The names of the successful contestants have just been announced in the "Better-Business" window-display contest recently conducted by the National Lamp Works of the General Electric Company. Sixty prizes,

PRIZE-WINNING DISPLAY—LEHIGH VALLEY LIGHT & POWER CO.

ranging from an automobile to a five-dollar gold piece, were awarded, to which were added eighty "honorable mentions" of $1 each.

The contest was carefully planned to give each distributer of National Mazda lamps equal opportunity to win any of the fifty general awards or the special award offered for distributers in his class or territory. One feature which stimulated interest in the contest was the stipulation that any contestant was privileged to enter as many displays as he wished.

Entries were judged on a scale of ten points, divided as follows: Selling value, five points; attention value, two points; unusual ideas, two points; harmonious arrangement, one point. The judges were Homer E. Niesz, Commonwealth Edison Company, Chicago, thirteenth past-Jupiter of the Jovian Order; A. J. Edgell, Society for Electrical Development, president of the International Display Managers' Association, and N. H. Boynton, manager of the publicity department of the National Lamp Works.

The first prize was awarded to the Lehigh Valley Light & Power Company of Allentown, Pa., for a clever display which told a convincing story about Mazda lamps through the medium of a series of seventeen placards changed by a twelve-year-old girl. The window was arranged to represent the library of a home, with lamps and the placards as the centers of attention. So effective was the display that more than 1500 lamps were retailed during the two days it was in operation.

Public Service Commission News

Indiana Commission

The Indiana Public Service Commission has indicated to representatives of the Indiana & Michigan Electric Company that the new schedule of compromise rates for residential and commercial lighting and power in South Bend and Elkhart will be approved by the commission when two small items in the power-rate schedules are changed in form slightly to correspond to the anti-discrimination provisions of the Indiana utility law. By the terms of the compromise the company, in return for a voluntary reduction in rates, is permitted to retain as the valuation of its properties its own figure, which is in excess of that re-established by the commission. Had the company accepted the commission's valuation, it would not have been able to do any new financing to take care of necessary improvements and expenditures until a substantial amount of the present funded debt had been called in. Under the new schedules the cities of South Bend and Elkhart will obtain residential rates ranging from 7.5 cents a kilowatt-hour net down to 4 cents. Commercial lighting will be on the same basis, except that the last step for this class will be 3.5 cents. The power rates, with the exception of the two schedules for large consumers, will remain practically as they were before the rate-making negotiations began.

Wisconsin Commission

The question of interlocking ownership was brought before the Railroad Commission of Wisconsin in a complaint charging the Hussa Brothers Light & Water Company with excessive rates. The lighting company's plant, it was brought out, was used jointly by the Hussa Brewing Company, to employees and stockholders of which company free service was rendered. The commission held that the rendering of free service to stockholders and employees of the brewing company is illegal and must be discontinued, and that the affairs of the two companies should be entirely separated.

It was further held in this case, regarding the subject of minimum rates and meter charges, that since utilities are required to furnish meters, the interest on which is carried by the general investment allowed, a monthly meter rental of 25 cents should be discontinued and there should be substituted a minimum bill to cover consumer costs. The minimum bill allowed by the commission was 75 cents per horsepower per month for all power customers and $1 per month for mixed consumers, or those using light and having less than 1 hp. of power load supplied through the same meter.

The commission, in considering the application of the light and water commission of the city of Barron for authority to adjust rates, rules and regulations, has laid down a policy to be followed by municipal plants in their relations with the cities in which they are established. The commission held that it is good business policy to treat a municipal water plant or electric plant as an enterprise separate and distinct from the municipality itself and have accounts kept accordingly, and that the city, if such policy is followed, should pay the utility at a reasonable rate for all service rendered the city, in order to avoid unjust discrimination in favor of the taxpayers of the city as against the consumers. The city should also provide all funds required for plant extensions, etc., and the utility, on the other hand, should pay the city a reasonable amount as taxes and as interest on the city's equity in the property of the utility, in order to avoid unjust discrimination in favor of the consumers as against the taxpayers.

That the loss of part of a public-utility property through "an act of God" should not be borne entirely by the company, but also by the customers, was the substance of a decision of the Wisconsin commission in a case involving the rates of the Viola Light & Power Company. Certain reductions in rates were ordered by the commission, but not all that the operating expenses would apparently allow. The commission held that the operating expenses of the company as reported to the commission appeared abnormally high, when compared with the expenses of other plants similarly situated, and that on the basis of an allowance of reasonable operating expenses some reduction in rates was possible, but that a still further reduction should not be made at the present time in view of the necessity of amortizing some of the early losses suffered by the plant, and in view of the necessity of the company's changing its policy of requiring customers to furnish meters to accord with the provisions of the public utilities law, which provides that the utility must own all of the equipment, the company having undertaken to furnish meters hereafter to customers and to acquire by purchase the meters now owned by consumers.

The "early losses" referred to which must be amortized are the washing out of the company's dam on the Kickapoo River two weeks after the plant had been put in operation. This made it necessary to erect and maintain a cofferdam for two years until the completion of a second concrete dam.

Pennsylvania Commission

An opinion has been filed by Commissioner Breit overruling the objections filed by the borough of Lansdale to the granting of a certificate of public convenience to the Towamensing Electric Company to operate in the township of that name in Montgomery County, and the charter application will be sent to the Governor. The decision was rendered in a case which has attracted general attention because of the effect it may have in other parts of the State. The borough furnishes power to consumers living outside of its limits and declared through its representatives that it was furnishing enough to meet the demand.

The opinion says that the borough claims to have the right to furnish power outside of its corporate limits, under the borough code, but that this question need not be determined now. The commission declares that "it could not be safely maintained when service is furnished from the surplus current of a municipal plant that the same diligent effort will be made to develop the territory and install facilities within the reach of everyone desiring service as would be the case with a private company, since the latter is always more or less engaged in seeking ways and means of pushing forward its plant operations."

New York Commissions

The Public Service Commission for the First District has requested the Interborough Rapid Transit Company to make provision for supplying electricity to the New York Municipal Railway Corporation for the operation of its lines under the dual-system contracts. These contracts allow the New York Municipal Corporation to purchase power for ten years after the new system is placed in operation. The Interborough will have powerhouse capacity to produce much more electricity than it will need for the operation of its own system, and the commission therefore suggests that it will be a saving both to the companies and to the city if it should allow the New York Municipal Corporation to purchase the needed energy. In this connection the New York Municipal Railway Corporation recently submitted a proposal to the commission to purchase energy from the Transit Development Company at a flat rate of 1 cent per kilowatt-hour. The commission disapproved this proposal on the ground that the flat rate was too high.

Electric Vehicles in England.—There were in use in England at the end of 1915 660 electric vehicles, as compared with 150 at the end of 1914.

Switzerland to Electrify All Its Railroads.—News comes by way of London of the intention of the Swiss government to transform all its federal railways into an electrified system. The estimated cost is put at $100,000,000.

Cost of Electrical Work at Panama-Pacific Exposition.—The electrical work in the twelve main buildings at the Panama-Pacific International Exposition cost $52,014, or a little over 1 per cent of the total cost of these buildings.

Educational Monthly Issued by Contractor.—*Current Topics* is the name of an educational electrical paper which is being issued monthly by the Tri-City Electric Company of Davenport, Iowa, and Moline, Ill. The paper is written for the customers and prospective customers of the firm.

Work to Be Resumed on 40,000-hp. Mexican Plant.—The Mexican Northern Power Company will soon resume work on its 40,000-hp. hydroelectric project at Hoquilla, in the State of Chihuahua, Mexico. The dam across the Conchos River came through the revolutions unscathed, and the hydroelectric plant and power transmission system will be built as soon as possible.

Increasing Use of Pocket Flashlamps in England.—Some interesting facts concerning the boom of electric pocket flashlamps appear in the *Daily Mail* of London. According to that publication, two London firms have produced between them no less than 2,000,000 batteries during the past year. Prior to the war only about 50,000 such batteries were made in the United Kingdom in twelve months. One manufacturer now has a staff of 400, mostly women, doing nothing else but making flashlamp batteries.

Russian Central-Station Statistics.—According to published statistics of Russian electric-light stations in which particulars of about eighty of the 225 stations are given, forty-seven stations possess steam plants of a total rating of 221,000 kw., sixteen stations have oil or gas engines of a total rating of 9572 kw., and sixteen stations, with a rating of 9692 kw., have both steam engines and internal-combustion engines. Only one station (in Suchum Kale, Caucasia, a town of 30,000 inhabitants) uses water-power. It possesses horizontal 435-kw. Francis turbines.

Recording Telephone Messages in Load Dispatching.—At the power house of the Pennsylvania Water & Power Company and at the Highlandtown substation all telephone messages regarding load dispatching are recorded on a dictaphone cylinder. The mouthpiece of the dictaphone is fastened right above that of the telephone, and all messages received are repeated. The cylinders from the two stations serve as a check on each other. If one station is slow in answering, it will be revealed by a difference in the recorded time on each cylinder.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

St. Paul Discontinues Gasoline Lamps.—The city of St. Paul, Minn., on Jan. 1 discontinued the use of 1000 gasoline street lamps. They were superseded by 250-watt electric lamps installed by the St. Paul Gas Light Company, which furnishes energy for the lights at a rate of $30 a year. They were installed on the old poles and will be maintained by the city.

Governor Makes Nominations for New York Commissions. — Governor Whitman of New York State sent to the Senate this week the nomination of Travis H. Whitney and Charles S. Hervey as members of the Public Service Commission for the First District, and of Frank Irvine, a former Cornell professor, who has been a Public Service Commissioner since 1914, for a five-year term on the commission for the Second District.

Tacoma to Prevent Sale of Energy by Isolated Plants.—Following reports that owners of business blocks operating steam-heating and electric plants in Tacoma, Wash., are selling electric energy for lighting, the City Council is having a report made on the matter. The city charter prevents private corporations or individuals going into the commercial lighting business in competition with the Tacoma municipal plant. If it is found that private parties are selling electric energy, the Council will institute proceedings to have the practice discontinued.

Water Powers of Europe.—Statistics of the Imperial Russian Technical Society show the available water-power in European Russia, including Finland, the Urals and Caucasia, to be roughly 30,400,000 hp. The potential water-power of Germany, chiefly in Bavaria, is about 1,000,500 hp., that of Switzerland 2,532,000 hp., and that of Sweden more than 6,000,000 hp. Of Sweden's available water-power about 3,500,000 hp. is not yet utilized. In Switzerland 300,000 hp. and in Italy, in the Piedmont province alone, more than 400,000 hp. is utilized, whereas hardly 250,000 hp. is utilized in Russia.

The Value of Indiana's Utilities.—In a paper presented before the February meeting of the Indiana Engineering Society H. O. Garman, chief engineer of the Public Service Commission of Indiana, said: "In this State there are approximately 1100 telephone exchanges valued at $35,000,000, 349 electric utilities valued at $69,438,000, 286 water utilities valued at $21,662,000, 67 artificial gas utilities valued at $31,670,000, 8500 miles of steam railways valued at $476,204,000, and 3000 miles of interurban and street railways valued at $102,000,000."

Amount of Tungsten Used in Incandescent-Lamp Manufacture. — The amount of standard tungsten ore used in the manufacture of incandescent lamps in the United States in 1915 was in the neighborhood of 4½ tons.

Many Women Holders of Public-Utility Stocks. — Statistics recently compiled concerning fifteen representative public utilities in different parts of the United States revealed that of a total of 40,015 stockholders 15,512 were women.

Tax on Electricity in Russia.—Respecting the contemplated taxation of electricity in Russia, it is stated that, according to preliminary calculations of the Ministry of Finance, this particular tax is expected to yield about 17,500,000 rubles ($13,000,000) a year.

Group Insurance for Rochester Railway & Light Employees.—The Rochester Railway & Light Company contemplates insuring all of its employees under the group plan, the company to contribute one-half of the dues of those who are members of the benevolent association. Policies will be for $1,000.

Baltimore's December Peak Breaks Record.—The December peak load of the Consolidated Gas, Electric Light & Power Company of Baltimore, which was 40,580 kw. for one hour, broke all records. It was 33 per cent higher than the 1914 peak. The output for the month was 18,774,650 kw.-hr., or 48 per cent more than that of 1914.

Minneapolis Company's New-Business Growth.—During the year 1915 the Minneapolis General Electric Company increased its number of electric customers more than 7000, its lighting load by 9400 kw., and its power load by 5000 hp. During the year 1990 already-built houses were wired on contracts secured by the company's sales department, and 11,178 electric household appliances were sold by the various appliance dealers and the company.

Brooklyn Edison's Maximum Load Increased by 26 per Cent in 1915.—The maximum load of the Edison Electric Illuminating Company of Brooklyn, N. Y., was 62,000 kw. in 1915, an increase of 12,700 kw., or 26 per cent, over 1914. The largest daily output during 1915 was 805,100 kw.-hr., which is 215,100 kw.-hr., or 36 per cent, greater than the maximum for 1914. The 1915 output was 143,997,941 kw.-hr., or 31,720,515 kw.-hr. greater than the 1914 output.

Alton Gas & Electric Franchise Repealed.—The City Council of Alton, Ill., has repealed a fifty-year franchise, which was to begin in 1918, granted on Nov. 22, 1908, to the Alton Gas & Electric Company. The repeal was in the nature of a retaliation because of the failure of the electric company to build an extension of its street-car service to the site of the new State Insane Hospital. The electric company now is operating under a twenty-year franchise granted it on March 10, 1898. The Council acted on the advice of the corporation counsel, who held that as the fifty-year franchise had not been entered upon it could be repealed.

Co-operation Dinner Given by Greenville (Ohio) Electric Company.—Merchants and citizens of Greenville, Ohio, and neighboring towns which are served by the lines of the Greenville Electric Light & Power Company were the guests of the company at a "co-operation dinner" Feb. 2.

Ohio Industrial Safety Exposition.—The second annual Ohio industrial safety exposition was held at Cleveland during the week ended Jan. 29. Almost every phase of safety work was discussed at the meetings held during the exposition. Data relating to accidents in different occupations and compensation during certain periods were presented, and guards for various machines and appliances, danger signals, samples of imperfectly constructed boilers and accessories, as well as approved types, were displayed.

Energy Required by the Panama-Pacific Exposition.—The electrical energy which was consumed by the Panama-Pacific International Exposition and which was supplied by the Pacific Gas & Electric Company amounted to 2,334,953 kw.-hr. during the pre-Exposition and post-Exposition periods and to 15,986,085 kw.-hr. during the Exposition period proper, a total of 18,321,038 kw.-hr. The revenue derived from the sale of this energy was $320,211. The peak load was 8200 kw., and came on Feb. 20, 1915. The largest daily energy consumption was over 80,000 kw.-hr., which was used on the first day of the closing week.

Telephone Development in Largest Cities.—The latest statistics compiled by the Bell Telephone Company, giving the average number of people to every Bell telephone in some of the largest cities in the United States, place Chicago and Albany in the lead, with 6.1 people to a telephone. Los Angeles is next with 6.8, followed by Washington with 7.2 and Detroit with 7.8. Boston has 8.4, New York 8.5, and Philadelphia 11.5. Jersey City showed the least development, with one telephone to every 23.8 people. Other cities are as follows: St. Louis, 12.7; Pittsburgh, 11.5; Cleveland, 11.9; Newark, 15.6; Buffalo, 12.3; Providence, 10.1, and Rochester, 16.1; while the average of all of these cities was 11.2.

New York Commission to Decide Whether Utility or Apartment-House Owner Shall Supply Tenants' Meters.—An investigation was started this week by the Public Service Commission for the First District of New York into the question of whether the electric-lighting company or the apartment-house owner shall supply tenants in large apartment houses with individual service meters. The matter came up through the action of the commission a few months ago in ordering a general cut in rates for electricity. Two of the commissioners then took the ground that the company should be required to supply only one meter for each service which it performed. This meant that in a large building containing many tenants the owners of the building would have to install individual meters.

Illumination Load and Cost at Panama-Pacific Exposition.—Excluding the State and foreign section, the illumination of the buildings and grounds of the Panama-Pacific International Exposition produced a load of 5216 kw., of which 1700 kw. was for searchlamps, 450 kw. for arc lamps and 3066 kw. for incandescent lamps. The electric illumination cost $630 per night for energy and $135 per night for labor, repairs and maintenance.

French Academy of Sciences Physics Prize for Pupin.—The Hébert prize for physics has been awarded by the French Academy of Sciences to Prof. M. I. Pupin for his important services to telegraphy and telephony and his method of harmonic analysis. Professor Pupin has turned over the prize, which was 1000 francs (about $200), to a fund for women and children who have been made widows and orphans by the present European war. The Hughes prize was awarded by the Academy to M. R. Marcelin, a young scientist of the first rank, and the Gaston Planté prize to M. Marcel Molin for his researches in radiation. Both of these men were killed in September, 1914. Of the thirty-seven awards made, eleven were to men who fell in battle.

Large Increase in Public Utilities Securities Held by American Banks.—The report of the comptroller of currency for the year ended June 30, 1915, shows that the largest increase in percentage of security holdings by banks of the United States during the year occurred in those of public utilities. The increase in percentage was 30.7, while the increase in gross was $80,000,000, or the second largest gross increase. Savings banks show the largest increase in holdings of public-service bonds other than those of railroads. National banks increased their holdings of public-utility securities by only $2,000,000. State banks increased their holdings of public-utility issues by about $16,000,000. On June 23, 1915, there were held by banks of the United States public-utility securities to the total value of $663,900,000, compared with $583,900,000 on June 30, 1914.

Plans for Government Control of Energy Supply in Saxony.—Plans have been laid for the government control of all central-station plants and distribution systems in Saxony and, according to the latest dispatches, will in all probability be favorably acted upon by both legislative bodies of the state. Besides purchasing a number of central stations, it is proposed to erect two or more large steam-power plants and to construct a high-voltage transmission and distribution system. The entire undertaking, if carried out, will cost the state in the neighborhood of $15,000,000. The first plant will be erected at Regis, near Leipzig, at a cost of about $2,500,000, and the second near Dresden at a cost of about $3,250,000. Estimates place the cost of the high-voltage transmission and distribution system at $2,500,000. Large coal fields have already been acquired by the government near Regis and Dresden.

Safety Dinner at Chicago.—The central committee on safety of the Commonwealth Edison Company on Jan. 31 gave the intermediate safety committees, which are composed of the company's foremen and men of higher rank, a complimentary dinner. W. L. Abbott, vice-chairman of the central committee, presided, and addresses were delivered by the following men: Samuel Insull, president of the Commonwealth Edison Company, on "The Fundamental Importance of Co-operation in Safety Work"; Charles B. Scott, manager of the Safety Bureau, on "Personal Caution," and Scott C. Robinson of the Commonwealth Edison Company on "A Résumé of Last Year's Safety Campaign." Mr. Insull also presented John Botefuhr, who during the year had saved the life of a fellow workman, with a gold medal. During 1915 there was but one fatal accident among the company's employees, although the average for past years amounted to seven.

International Engineering Congress Proceedings.—The committee of management, International Engineering Congress, 1915, announces that the volume on mechanical engineering is ready for distribution, and the members who have subscribed to this volume will soon receive it. The other volumes will be issued as rapidly as possible. Owing to the large amount of material to be reprinted and the thousands of copies to be bound, the work cannot be carried on with greater speed. However, it is hoped that within two months the entire set will be completed. Members who did not send in their final selections may be disappointed in not securing all the volumes they might have had in mind, and at this date the committee has decided to close the lists for certain volumes which have been sent to the press. It may be possible to supply members who apply at this late hour with copies of volumes which have not gone to press. W. A. Cattell, 425 Foxcroft Building, San Francisco, is secretary.

Government to Test Radio Preparedness for Mobilization Purposes on Washington's Birthday.—On Feb. 22 the government will make its first move toward testing radio preparedness for the purpose of quickly mobilizing military forces in every part of the country, when a war message will be flashed out from the Rock Island (Ill.) arsenal station. At 11 o'clock, central time, on the night of Feb. 21, a "stand-by" message will be sent out, after which the federal government will deliver by messenger a military dispatch to the Rock Island Arsenal. This message, the contents of which will be unknown to the Rock Island operator up to the time the messenger delivers it, will be sent out to be picked up by all stations within hearing distance. Forty-five stations have been designated to relay the message, which will be delivered in every city or state to the mayor or governor. It is admitted in government circles that the whole plan is to learn how quickly an army of 3,000,000 soldiers could be mobilized in the event of a national emergency.

Cleveland Engineering Society.—On Jan. 25 Major S. P. Bond, in charge of the Cleveland division, addressed the Cleveland Engineering Society on the engineering training that is given at West Point.

Jovian League Organized at New Orleans, La.—With Col. Joseph H. De Grange, secretary of the New Orleans Railway & Light Company, as president, a Jovian League has been organized at New Orleans, La.

Los Angeles Jovian League.—Rev. Charles C. Selecman, pastor of Trinity Auditorium, spoke before the Los Angeles Jovian League on Jan. 26 on "The Conversion of Jove." The league will hold its next Jovian rejuvenation on Feb. 18.

Detroit Engineering Society.—The next meeting of the Detroit Engineering Society will be held Feb. 18. Charles L. Weil, engineer for the Diamond Crystal Salt Company, will talk on "Notes on the Salt-Making Industry."

South Dakota Electrical Association.—Central-station owners and operators in the State of South Dakota propose to organize an electrical association, and a preliminary meeting for that purpose has been called for Feb. 22 at the Hotel Carpenter, Sioux Falls, S. D.

Electrical Supply Jobbers' Association.—At the coming meeting of the Electrical Supply Jobbers' Association to be held in the Hotel Statler, Detroit, Mich., Feb. 15, 16 and 17, Edward N. Hurley, vice-chairman of the Federal Trade Commission, will address the association at an open manufacturers' session, Feb. 15.

Convention of Pennsylvania Electric Association.—At a meeting of the executive committee of the Pennsylvania Electric Association (State branch of the National Electric Light Association) held in Harrisburg, Feb. 3, it was decided to hold the 1916 convention of the association at the Forest Inn, Eagles Mere, Pa., Sept. 5, 6, 7 and 8.

Ohio Electric Light Association.—The committee in charge of the 1916 convention of the Ohio Electric Light Association to be held at Cedar Point, Ohio, July 18, 19, 20 and 21, consists of G. E. Miller, Cleveland; W. S. Culver, C. J. Ratterman and H. J. Hoover, Cincinnati; A. A. Serva, Fort Wayne, Ind.; W. E. Richards, Toledo, and George S. Vail, Cleveland.

Empire State Gas and Electric Association.—At the "electric production meeting" of the Empire State Gas and Electric Association on Jan 14 at Binghamton, N. Y., these topics were discussed: "Production Costs," "Centrifugal Versus Reciprocating Boiler-Feed Pumps," and "Boiler-Room Efficiency Apparatus." The regular monthly meeting of the executive committee was held on Jan. 19.

Convention of Iowa Section, N. E. L. A.—The Iowa Street & Interurban Railway Association, the Iowa District Gas Association and the Iowa Section of the National Electric Light Association will hold a joint convention at the Julian Dubuque Hotel at Dubuque, Iowa, on May 10, 11 and 12. It was originally planned to hold this meeting a week later, but on account of the National Electric Light Association's convention at Chicago during the week of May 22 the dates were changed.

Associations and Societies

A complete Directory of Electrical Associations is regularly printed in the first issue of each month on the next-to-last text page.

The Radio Club of America.—The next meeting of the Radio Club of America will be held Feb. 18, at 8.15 p. m., in Room 301, Engineering Building, Columbia University, New York City. Dr. J. Zenneck will present a paper on "Problems in Modern Radio Engineering." In a non-mathematical discussion the most recent theories of the operation of many elements of radio apparatus will be considered, together with their application to the practice of communication.

San Francisco Section, A. I. E. E.—The San Francisco Section of the A. I. E. E. held the first regular monthly meeting since the close of the Exposition period at the Engineers' Club on Jan. 28. After the strenuous convention season and with the large number of technical papers and discussions fresh in mind, it was thought advisable to make this meeting simply a "smoker and jollification." The program consisted of impromptu addresses followed by several reels of moving pictures.

Western Association of Electrical Inspectors.—The following officers have been elected by the Western Association of Electrical Inspectors to serve for the ensuing year: President, F. H. Moore, Indianapolis, Ind.; first vice-president, Emil Anderson, Milwaukee, Wis.; second vice-president, F. L. Lucas, Toledo, Ohio; secretary-treasurer, William S. Boyd, Chicago; executive committee, C. K. Crieger of Chicago, A. J. Pruvot of Sioux City, H. F. Strickland of Toronto, H. B. Willifred of Denver, Ralph E. Knox of Louisville, and F. P. McGough of Omaha.

Electrical League and Engineering Society to Have Joint Quarters at Cleveland.—On Feb. 3 the members of the Electrical League of Cleveland approved a plan by which this organization and the Cleveland Engineering Society will join in obtaining permanent quarters at the Hotel Statler. The board of directors of the Engineering Society has approved the plan, and it will be submitted to the members soon. It provides for inclosing the east wing of the Statler roof garden. Each organization would have separate offices, club rooms, committee rooms and libraries, but the assembly hall and dining-room would be used jointly. The Electrical League is now established in the Hollenden Hotel, while the Engineering Society has quarters in the Chamber of Commerce building.

California Association of Electrical Contractors and Dealers.—The California Association of Electrical Contractors and Dealers held its quarterly meeting on Jan. 21 at the Palace Hotel in San Francisco. Committee reports were received and the by-laws were revised so as to specify the qualifications for membership. Representatives from the jobbers and central stations were present by invitation at the dinner in the evening. R. S. Holabird spoke on the new prices for heating appliances owing to the nickel-chromium patent situation, and J. A. Cleary outlined the changes in the new electrical code and explained what it meant to the contractor. W. S. Hanbridge, the retiring secretary, was presented with a silver service. The last speaker, S. J. Lisberger of the Pacific Gas & Electric Company, gave a stereopticon lecture on the methods of laying a power cable across the Golden Gate.

Program for Illinois State Electrical Association Meeting.—The program for the fifteenth annual convention of the Illinois State Electrical Association, which is to be held at Champaign, Ill., Feb. 23 and 24, has been arranged as follows: Address of welcome by Edmund J. James, University of Illinois; president's address, by E. MacDonald, Lincoln, Ill.; "Boiler Efficiency," by Harry J. Klotz, Decatur, Ill.; "Voltage Regulation of Distribution Circuits," by Prof. E. B. Paine, University of Illinois; "Are Steam-Heat Plants Profitable in Towns of 10,000 and Less Population When Operated in Conjunction with Central Stations?" by H. R. Wetherell, Peoria, Ill.; "Electric Cooking," by J. Paul Clayton, Mattoon, Ill., and "Making Rates for Towns of 2500 and Less Population," by Prof. Morgan Brooks, University of Illinois. On Wednesday evening the delegates will be the guests of the supply men at a banquet and theater party. H. E. Chubbuck of Peoria, Ill., is secretary of the association.

Executive Committee Meeting, N. E. C. A.—A meeting of the executive committee of the National Electrical Contractors' Association was held in Richmond, Va., on Monday and Tuesday of this week. Matters of routine nature concerning the executive side of the association were discussed, with particular emphasis on liability insurance, the Underwriters' code, and the annual convention, which will be held in New York City some time during July. The 1917 convention will be held in New Orleans in October of that year. The following members of the executive committee were present at the meeting: Industrial development, John R. Galloway of Washington; universal data and sales book, G. M. Sanborn of Indianapolis and J. A. Fowler of Memphis; national code. E. McCleary of Detroit and W. C. Peet of New York; membership, J. T. Marron of Rock Island, Ill.; legislation, P. H. Jaeknig of Newark, N. J.; national convention, J. R. Strong and G. H. Duffield of New York and J. M. Richardson and W. R. Englesby of Roanoke, Va.

FINANCE, COMMERCE AND INDUSTRY

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

Manufacturing and Industrial

Outlook for the Fan Season of 1916 Is Encouraging

A spirit of optimism prevails in the electric-fan trade. Prominent fan manufacturers seem inclined to believe that the demand for fans this summer will be large. In canvassing the country in preparation for the fan campaign the sales forces of the different producers have been making encouraging reports. While a large number of inquiries have already been received, although the campaign has hardly been started and the season is still some months away, the reasons for expecting a good demand for fans are mostly speculative. This is necessarily so from the very nature of the business, which is as uncertain as the weather, not figuratively but literally. The weather is the controlling factor. A wet, cold, disagreeable summer is the worst thing that could happen to fan dealers, while an early, hot, dry summer will boost fan sales until stocks are exhausted. Because, however, last summer was cold and disagreeable and because the summer before was not much better, it is rather expected that the United States is due for the return swing of the pendulum. Fan weather is the prediction of the fan manufacturers for 1916.

Provided that the 1916 fan season opens early with blistering hot weather, there is a further reason for expecting record sales; for should a curve of unusual fan sales be plotted it would be seen that the tendency each year is upward. Therefore, since in 1915, owing to adverse weather conditions, fan sales were below normal, there was left at the end of the season unfilled potential orders equal to the difference between the actual sales and the estimated sales for normal conditions. While it is not expected that this volume of unfilled potential orders will be added to the normal 1916 sales, it is thought that included in these potential orders are many orders that are merely waiting for satisfactory weather conditions. It might be said that in these cases the product has already been sold and is waiting for delivery until a need arises. With a normal season fan producers think this business will be added to the otherwise expected normal 1916 sales.

From the standpoint of the manufacturers, however, there is just one element of uncertainty. Dealers, jobbers and retailers in general stocked up pretty well early in 1915. Intensive campaigns on the part of some of the larger distributers were largely responsible for this condition. Since the 1915 season proved to be such a poor fan season, the dealers find themselves starting out in 1916 with rather large stocks left over from the previous year. Now, while the manufacturer feels certain that the retailer is going to have an excellent season, there is just the least shade of uncertainty as to whether the manufacturers are going to feel these large sales. In fact, one rather prominent maker of fans has decided to make but a limited number this year because he feels that the dealers are already heavily stocked.

One other reason was given for expecting a satisfactory demand for electric fans this coming summer, and that was the general prosperity of the nation at large. While for the last two years the keynote of all has been economy, the changed conditions of 1916 will, it is expected, cause a freer expenditure of money, and consequently a large sale of electric fans.

In spite, however, of the larger amount of money in the United States and in spite of the general prosperity, the manufacturers are making their strongest appeal this year in the less expensive types. Some have produced very small fans to sell in the neighborhood of $6 to $7.50. Others are making their drive in fans in which the housing is made of less expensive material—in one instance, cast-iron instead of steel. While strong efforts will be put forth to get business from all sources, the particular appeal this season will be for the small customer—the individual user. Electric fans for stores, barber shops, large offices and factories, restaurants, etc., are old ideas. This field has been so well developed that electric fans for such places are commodities, necessities. The field is nearly saturated, and while business from this direction will continue to be good, some new field must now be opened to provide for growth in the fan industry. This field is the individual user—the household, the desk, the ticket booth, etc. This is the largest field of all, the field which until a couple of years ago was practically untouched and unknown. But by national advertising, general education and inexpensive fans, with an added provision of an early, hot summer, fan producers feel that the individual user will lead the 1916 demand, if not in value of sales, at least in volume of sales.

There will be no difficulty in making deliveries provided that the railroads do not delay shipments. All of the manufacturers have stocked up well and will be able to handle orders for immediate delivery from stock for some time. They began their buying of raw materials before the boom came along and were therefore able to get their supplies in good season and at reasonable prices.

Prices on fans have not advanced and are not likely to advance. Stocks were laid in early and no special trouble was had with labor. It therefore was possible to manufacture fans as cheaply for the 1916 market as previously.

Credits will be more carefully looked into this year than ever before. Dealers will not be allowed to stock up beyond their apparent turn-over capacity. The manufacturers will discourage large single orders, preferring the same volume of sales in more orders. This, it is stated, will be done solely for the benefit of the dealer, as it will lessen his financial obligations and enable him to do just as large a business on far less investment. By this means the manufacturers will be able to prevent as far as possible the carrying of any appreciable amount of 1916 stock over into 1917. Large orders will have to be accompanied with the very best financial and commercial references. Collections therefore will be good.

New Procedure in Filing Declaration for Exports.—The Department of Commerce has issued a pamphlet describing the new shippers' export declaration and export procedure, which are amendatory of and supersede the provisions of the treasury decision issued on Sept. 15.

The Wagner Electric Manufacturing Company, St. Louis, Mo., has opened a new office in the Mills Building, El Paso, Tex., which will be in charge of F. B. Hitchings with title of local manager. This new office is under the supervision of O. H. Davidson, district manager of the Wagner Company with headquarters in Denver.

The Bleadon-Dunn Company, a manufacturer of electrical specialty devices, has been forced by increasing business to quarters three times larger than those formerly occupied. The Chicago address of the concern still remains 208 Fifth Avenue, since the change does not take the company out of the building it has occupied.

Brown & Ross, Inc., 383 Dwight Street, Springfield, Mass., have recently become engaged in the electrical supply business, G. H. Brown, formerly with the Belcher & Loomis Company, is president of the concern, and A. N. Ross, Northeastern representative for Pass & Seymour, Inc., for three years, is secretary and treasurer. The company will act as wholesale jobber exclusively for electrical contractors and will do no contracting or fixture work.

The Thomas B. Jeffery Company, Kenosha, Wis., has appointed A. P. Peck construction engineer. Mr. Peck was recently Chicago district sales manager for the Terry Steam Turbine Company and the Smith-Serrell Company. Mr. Peck was also formerly connected with the New York office of the Allis-Chalmers Company as district engineer.

New Factory for Ward Leonard Company.—The Ward Leonard Electric Company, maker of speed-control systems, will, in order to take care of its increasing business, enlarge its plant in the near future. The contract for the erection of a two-story factory at the corner of Pearl and South Streets, Mount Vernon, N. Y., has just been placed with the John W. Ferguson Company of New York and Paterson, N. J. The building, measuring 83 ft. by 153 ft. in plan, will follow regular mill-construction lines and be covered by a slag and felt roof.

Large Cedar-Pole Grant.—On Dec. 16, 1915, the Bell Lumber Company, Minneapolis, Minn., manufacturer of white-cedar posts, poles, pilings and ties, as the result of a previous bid was awarded the cedar on all of the tribal lands of the Odanah Indian Reservation. The company had already secured all of the other timber on the reservation three years ago and with its holdings elsewhere will have sufficient white cedar on hand, it claims, for at least ten or twelve years' operations. The company has already started to operate camps on the reservation at various points for producing poles to supply the summer and spring trade.

The Bailey Meter Company, 141 Milk Street, Boston, Mass., has recently been incorporated under the laws of Massachusetts to manufacture and sell a line of recording meters and instruments for power plants and other similar uses. The meters have been developed during the past six years in the mechanical engineering department of the Fuel Testing Company of Boston. Mr. E. G. Bailey will devote his entire time to the new company, but the Fuel Testing Company will continue its regular work under the direction of W. B. Calkins, who has been a partner with Mr. Bailey since the organization of the latter-named company in 1909.

Orders for Water Turbines.—The I. P. Morris Company of Philadelphia, Pa., has recently been awarded the contract for four 5250-hp. horizontal-shaft, single-volute-casing, double-discharge turbines, which are to operate under a head of 108 ft. and at a speed of 240 r.p.m. and which are to be installed in the plant of the Great Northern Paper Company of Millinocket, Me. The Utah Power & Light Company has also made arrangements to install an additional water turbine of I. P. Morris manufacture for use in its Oneida plant. This water turbine will be rated at 15,000 hp. and will be of the vertical-shaft single-runner type and designed to operate under a head of 140 ft. and at a speed of 180 r.p.m. The set is a duplicate of two previously furnished for the plant.

Manufacturers Organize to Promote Trade in Russia.—Twenty-five non-competing American manufacturers have organized a concern known as the International Manufacturers' Sales Company of America to promote trade in their lines in Russia. The membership list in the new company is later to be increased to fifty. At present the main office of the concern is at 1133 Rookery Building, Chicago, and the Russian headquarters is in Moscow. In forming this company the organizers received assistance from the United States government through Consul-General John Snodgrass in Moscow, various other consuls, and the Bureau of Foreign and Domestic Commerce offices at Washington, at Chicago and elsewhere in this country. The officers of the new association, elected at the first meeting of stockholders Jan. 19 in Chicago, are: President, A. S. Postnikoff, Chicago; first vice-president, Hobart Ames, Ames Shovel & Tool Company, Boston; second vice-president, E. C. Herring, Lawrence & Company, Boston; treasurer, B. T. Leuzarder, Chicago Belting Company, Chicago; secretary, L. N. Burns, J. I. Case Plow Works, Racine, Wis.; appointed director of sales in Russia, X. B. Kalamatiano, Moscow. Although no firm making heavy electrical equipment is as yet a member of the organization, the following concerns which are members do supply some goods to the electrical industry: Hart & Hegeman Manufacturing Company, Hartford, Conn.; American Steam Gage & Valve Manufacturing Company, Boston; Jeffrey Manufacturing Company, Columbus, Ohio, and the Chicago Belting Company, Chicago.

Benjamin Franklin's "Poor Richard's Almanack" Revived.—A unique and original bit of advertising has just been instituted by the Franklin Electric Manufacturing Company of Hartford, Conn., in a revival and revision of "Poor Richard's Almanack," that famous product of Benjamin Franklin's early efforts as a publisher. The application is particularly appropriate, for it takes no great stretch of the imagination to say that the Franklin Mazda lamp, which this new Poor Richard advertises, is the indirect outgrowth of Franklin's electrical experiments. "Poor Richard's New Almanack," as it is called, is a quaint little eight-page booklet, printed in old-fashioned type (including the long "s") on old-time paper and illustrated with the grotesque woodcut pictures characteristic of Franklin's time. The style and wit which won such immediate popularity for the original almanac are cleverly carried out, with a preface signed "Your poor friend and servant, R. Saunders," and a two-page typical almanac schedule for the month, in which there are many laughs. The February issue closes with a subtle sermon entitled "Poor Richard's advice to men who keep shoppes and to folk who go into them." The "almanack" is being distributed by Franklin dealers among their customers present and prospective.

Oil Engine Industry Flourishing in Sweden.—W. R. Haynie, president of the Marine Oil Engine Company, 30 Church Street, New York, a recently organized concern which will have the sole manufacturing and selling rights of the "Skandia" oil engines in the United States, recently returned from an extensive trip in Sweden. He reports that the Swedish manufacturers are very busy and that some of them will not be able to supply engines of certain types for months to come. Among the plants visited were those of the Polar-Diesel Engine Works of Stockholm, the parent concern of the McIntosh & Seymour Corporation of Auburn, N. Y., Swenson & Company of Stockholm, makers of the "Avance" engine, the Bolinders Company of Stockholm, the Lysekils Mek. Verkstods Aktiebolag of Lysekil, maker of the "Skandia" engine, and the Nya Aktiebolaget Atlas of Stockholm. An interesting feature of the plant of Swenson & Company, Mr. Haynie states, was a four-cylinder, 320-hp. engine which was directly connected to a generator supplying power for all the electric tools, machines, cranes, etc., in the plant. When he asked for information regarding the delivery of this type of engine, he was told that the demand had been so great that the earliest shipment that could be made would not be before sixteen months. The plant of this concern has been doubled in size and capacity in the past five years, and additions are being made so that its capacity will be increased a third. In the plant of the Polar-Diesel Engine Works Mr. Haynie saw two 1650-hp., two-stroke-cycle, six-cylinder marine engines and one 1000-hp. experimental engine in operation.

NEW YORK METAL MARKET PRICES

	Feb. 1 Selling Prices Bid	Feb. 1 Selling Prices Asked	Feb. 8 Selling Prices Bid	Feb. 8 Selling Prices Asked
Copper	£ s d	£ s d	£ s d	£ s d
London, standard spot	94 10 0		101 10 0	
Prime Lake	25.25	to 25.75†	26.50	to 27.50†
Electrolytic	25.25	to 25.75†	26.50	to 27.50†
Casting	24.12½	to 24.37½†	25.00	to 25.50†
Copper wire base	26.75	to 27.25†	27.75	to 28.25†
Lead	6.10		6.10	
Nickel	45.00	to 50.00	45.00	to 50.00
Sheet zinc, f.o.b. smelter	24.00†		24.00†	
Spelter	18.67½	to 18.92½	19.17½	to 19.42½
Tin, Straits	41.80		41.25	
Aluminum, 98 to 99 per cent.	53.00	to 55.00	52.00	to 54.00

OLD METALS

Heavy copper and wire	19.50	to 20.00†	20.00	to 21.00†
Brass, heavy	13.00	to 13.50†	13.50	to 14.00†
Brass, light	10.50	to 11.00†	11.00	to 11.25†
Lead, heavy	5.00	to 5.25†	5.00	to 5.25†
Zinc, scrap	15.00	to 15.25†	13.25	to 13.50†

COPPER EXPORTS

Total tons to Feb. 8 5,873

†Nominal.

Corporate and Financial

Alabama Power Company, Birmingham, Ala.—The gross earnings for the calendar year 1915 were $1,041,148, an increase of $421,399, or 68 per cent, over 1914. For the same period the net earnings amounted to $638,606, an increase of $331,143, or 108 per cent. December gross earnings were the largest for any one month, being $108,738, which is an increase of 40 per cent over December, 1914. In April the largest monthly percentage increase during 1915 was made in gross earnings, namely, 128 per cent. The gross earnings for this month were $86,487.

Central Maine Power Company, Augusta, Me.—In the annual report of the company to the stockholders for the calendar year 1915 W. S. Wyman, treasurer and general manager, makes the following statement: "The year 1915 taken as a whole was one of pretty nearly average business conditions. During the first half of the year extreme depression prevailed, but by July war orders placed with some of our leading manufacturers began to cause things to pick up, and during the last three months general business was rather above the normal. Many of our manufacturers were operating on full time and some of them on an eighteen-hour or a twenty-four-hour-a-day basis. During the closing months of 1915 we purchased the capital stock of the Bath & Brunswick Light & Power Company, of the Waldoboro Water & Electric Light & Power Company, of the Union Light & Power Company, and the capital stock and all outstanding obligations of the Penobscot Bay Electric Company, which in turn bought the property of the Greenville Light & Power Company. These purchases, together with the various extensions which are planned for 1916, will considerably increase the company's field. It is now doing business in nine counties of the sixteen which make up the State and is serving a population of approximately 150,000. It is impossible to tell what the effect on conditions here in Maine will be when the European war is brought to a close, but, making due allowance for considerable shrinkage from the present volume of manufacturing, we have estimated the gross income of the company from all sources for the year 1916 as $920,000. Considerable progress was made in 1915 in extending our lines into the smaller towns. Extensions of this character were built or have been projected into Unity, Thorndike, Brooks, Monroe, Winterport, Belgrade, Athens and Cornville. These lines enable us not only to reach the villages but in most cases to sell considerable energy to farmers along the road. In all towns mentioned above sufficient preferred stock was subscribed to by the residents to pay for the entire expense of building the necessary extensions. It is proposed to continue this work during the present year, and we believe that in the end the company will find this a profitable source of income, at the same time serving its territory much more completely. No new power developments have been made during the year, but it is believed that before long a new hydroelectric station of considerable capacity will be necessary." The financial results of the Central Maine Power Company's operations alone for 1915, as compared with 1914, are as follows:

Income	1915	1914
Sale of electricity	$521,868	$478,629
Sale of gas	36,603	34,621
Railway	89,078	93,613
Miscellaneous	10,698	13,156
Total income	$658,247	$620,019
Operating expenses	330,473	324,629
Net earnings	$327,774	$295,390
Interest	195,948	186,201
Balance	$131,826	$109,189
Preferred stock dividend	55,122	51,904
Balance	$76,704	$57,285
Depreciation	37,907	36,700
Balance	$38,797	$20,585

Cincinnati (Ohio) Gas & Electric Company.—Details regarding the financing of the proposed new electric power station to be built in Cincinnati for use by all of the public service companies in that vicinity have been agreed upon by directors of the Cincinnati Gas & Electric Company and A. B. Leach of A. B. Leach & Company, who control the Union Gas & Electric Company. The Cincinnati Gas & Electric Company, it is understood, will issue $15,000,000 of first mortgage bonds under the plan agreed upon, of which $4,000,000 will be issued at once to pay for the construction of the new plant, payment of interest being guaranteed by the Union Gas & Electric Company. The plant is to have a rating of not less than 50,000 kw. and will be so constructed that units can be added without difficulty. The question of issuing the bonds will be laid before the stockholders of the company at once by letter.

Columbus (Ohio) Railway, Power & Light Company.—An issue of $3,500,000 of first refunding and extension sinking-fund mortgage 5 per cent gold bonds, due Oct. 1, 1940, is being offered to investors at 97 and interest. The proceeds of this issue will be used for the purpose of paying off $2,639,000 of mortgage bonds and collateral-trust notes bearing 5 per cent and 6 per cent interest, for reimbursing the company for expenditures not previously capitalized, and for providing funds for reconstruction and additional working capital.

Detroit (Mich.) Edison Company.—In order to provide part of the funds to pay for extensions and additions the company has decided to issue part of the increased capital stock authorized Dec. 17, 1913. The right to subscribe at par to the new issue will be offered to stockholders at close of business March 3, 1916. Each stockholder will be entitled to subscribe for an amount equal to 15 per cent of his holdings.

Hebron (Ind.) Light, Heat & Power Company.—The company has increased its capital from $25,000 to $100,000.

Interstate Public Service Company, Indianapolis, Ind.—The Public Service Commission of Indiana has authorized the company to issue $67,000 of bonds to reimburse the company's treasury for plant equipment purchased for use in Greenwood, Seymour, Lebanon and other cities and towns.

Montana Power Company, Butte, Mont.—An issue of $1,000,000 of first and refunding mortgage 5 per cent gold bonds due July 1, 1943, is being offered at a price to yield about 5.2 per cent. The earnings for 1915 were as follows:

Gross earnings	$4,320,836
Operating expenses and taxes	1,191,694
Net income	$3,129,142
Interest charges	1,052,297
Balance	$2,076,845

Northern States Power Company, Chicago, Ill.—The company has increased its capital stock from $17,500,000 to $30,000,000 and has filed a change in the name of its principal operating subsidiary, the Consumers' Power Company, to Northern States Power Company. This is in line with the company's new policy of simplifying its corporate organization and will pave the way for a consolidation of the funded indebtedness of its subsidiaries. So far as possible all subsidiaries, including the Minneapolis General Electric Company, will be incorporated under the name of the holding company, the Northern States Power Company. The increase in stock will be used to retire the present stocks of subsidiary corporations, and when this is completed the Northern States Power Company will own these properties in fee instead of by stock ownership, and steps can be taken to put into effect a complete reorganization of the funded debts by consolidating present liens under one general mortgage. The way will then be opened for the payment of dividends on the common stock of the Northern States Power Company, on which the company is now earning in excess of 12 per cent.

Ohio Service Company, Cambridge, Ohio.—The company has been authorized by the Ohio Public Utilities Commission to issue $757,000 securities, from the proceeds of which it will purchase the property of the Coshocton Light & Heating Company.

Philadelphia Electric Company.—In presenting testimony before the commission in the case of the city of Philadelphia vs. the Philadelphia Electric Company, President Joseph B. McCall of the latter company gave some interesting figures tracing the development of his company since its incorporation. In submitting estimates of the present value of the stock of the Philadelphia Electric Company, Mr. McCall said that the Philadelphia Electric Company of New Jersey was incorporated on Oct. 5, 1899,

with a capitalization of $25,000,000 at a par value of $25 per share. The first assessment on this stock, amounting to 10 per cent, was made on Nov. 1, 1899, and the last one, an assessment of 20 per cent, was made on Dec. 1, 1913. The capital stock issued, he said, totals $24,987,750. Only $18.50 per share has actually been paid in, $4 having been credited to the stock from the surplus of the earnings. The average returns to stockholders since 1899 have been 7.42 per cent. Mr. McCall also showed that $15,014,142 worth of securities have been issued and that the total number of share and security holders is 14,300. He said the Philadelphia Electric Company of Pennsylvania, the defendant, was incorporated on Oct. 27, 1902, with an authorized capital stock of $25,000,000, of which $17,000,000 has been issued at a par value of $100.

Standard Gas & Electric Company, Chicago, Ill.—The 1915 earnings statement of the Standard Gas & Electric Company shows a balance of $664,042, after payment of bond interest, scrip, interest and allowance for interest on the new issue of $2,500,000 twenty-year 6 per cent gold notes, of which in excess of $2,300,000 have been purchased by investors. A comparative report of earnings for the years ended Nov. 30, 1915 and 1914, follows:

	1915	1914
Gross earnings	$1,525,251	$1,453,384
Expenses and taxes	42,032	37,092
Net earnings	$1,483,219	$1,416,292

The notes, which are offered at 92 and interest, will retire the company's short-maturity obligations, including the present outstanding 6 per cent serial notes due June 1, 1916.

Sullivan County Electric Company, Clinton, Ind.—The company has increased its capital stock from $60,000 to $150,000 and intends to furnish electric energy to many of the larger towns in Sullivan County, Ind.

New Utility and Industrial Companies

The Cromwell Light, Heat & Power Company of Mount Union, Pa., has been incorporated with a capital stock of $5,000 by John E. Zimmerman, Robert Shields and B. Marx, all of Philadelphia, Pa.

The Elliott-Thompson Electric Company of Cleveland, Ohio, has been incorporated with a capital stock of $20,000 by J. N. Elliott, M. B. Elliott and T. Howard. The company intends to deal in electrical machinery and supplies.

The Phoenix Electric Company of Chicago, Ill., has been incorporated with a capital stock of $30,000 to manufacture and deal in electrical machinery. The incorporators are L. C. Thesen, J. G. Bodenschatz and Benjamin Kortmeyer.

The Adirondack Motor Sales Corporation of Glens Falls, N. Y., has been incorporated by G. N. Nay, H. E. Floyd and E. V. Bulow, Hudson Falls. The company is capitalized at $25,000 and purposes to deal in autos and electric vehicles.

The Electrolladd Company of San Antonio, Tex., has been organized with a capital stock of $50,000 for the purpose of manufacturing electrical machinery and appliances. The incorporators are Richard M. Craig, E. N. Phillips and Charles K. Smith.

The Ernest Rubes Company of Brooklyn, N. Y., has filed articles of incorporation with a capital stock of $100,000 for the purpose of manufacturing electric lamps, plugs, devices, etc. The incorporators are L. E. and N. Rubes and L. Rannheim, 44 Court Street, Brooklyn, N. Y.

The Kent County Light, Heat & Power Company of Smyrna, Del., has been incorporated with a capital stock of $100,000 by D. Grant Richmond, Philadelphia, Pa.; Richard R. Kenney and Herbert M. Jones, Dover, Del. The company will supply light, heat and power in Smyrna and other towns.

The Galasso Company of New York, N. Y., has been incorporated with a capital stock of $5,000 for the purpose of doing general contracting, construction and electrical work. The incorporators are M. J. Goarity, Jacob J. Alexander and Robert C. Lipman, 790 Riverside Drive, New York, N. Y.

The Erickson Automatic Electric Water Purifier Company of Brooklyn, N. Y., has been incorporated by G. E. Erickson, 451 Ninth Street; C. E. Peterson, 157 South Portland Avenue, and F. Teden, 78 St. Mark's Avenue, Brooklyn, N. Y. The company is capitalized at $75,000 and purposes to manufacture machinery for purifying water, etc.

The Habirshaw Electric Cable Company of New York, N. Y., has been incorporated with a capital stock of $925,000 to manufacture and deal in wire, cables and all kinds of insulated wires, electric motors and other products. The incorporators are J. B. Guaraglia, Hoboken, N. J.; J. B. Murphy and J. S. Heep, 40 Wall Street, New York, N. Y.

Trade Publications

Circuit-Breaker Oscillogram.—The Roller-Smith Company, 203 Broadway, New York, is sending out an illustrated leaflet which contains an oscillogram obtained with an 80-amp. circuit-breaker.

Heating Devices.—The American Electrical Heater Company, Detroit, Mich., is sending out an illustrated folder which contains information on various types of its electrically operated heating devices.

Motor-Driven Controller.—The Speed Controller Company, 257 William Street, New York, has prepared an illustrated bulletin which contains information on its "Speedco" power and speed regulating controllers.

Single-Phase Motors.—The Century Electric Company, St. Louis, Mo., has issued a folder which shows applications of its single-phase motors to pumps, carbonators, organ blowers, vacuum cleaners and air compressors.

Fixture Glassware.—The Gleason-Tiebout Glass Company, 71 West Twenty-third Street, New York, has prepared an illustrated bulletin on its "Celestialite" lighting-fixture glassware, designed to give daylight color values.

Plugs and Receptacles.—Harvey Hubbell, Inc., Bridgeport, Conn., has prepared an attractively illustrated folder entitled "Hubbell Protection," which contains information on and illustrations of various types of plugs and receptacles.

Switchboard Devices and Voltage Indicator.—The General Electric Company, Schenectady, N. Y., has issued Bulletin No. 47,750, on "Switchboard Structural Devices and Accessories," and Bulletin No. 46,023, on an "Arc Circuit Voltage Indicator."

Oil Switches and Circuit-Breakers.—The Condit Electrical Manufacturing Company, Boston, Mass., has issued Bulletins No. 401-A, No. 401-B and No. 401-C on its type "ID" oil switches and oil circuit-breaker, Bulletin No. 410 on its type "PK-5" pole-line oil switches, and Bulletin No. 411 on its type "M-5" manhole oil switches.

Storage Batteries.—The Electric Storage Battery Company, Philadelphia, Pa., has issued Catalog Section IC on batteries for electric vehicles, Handbook RB on replacement batteries for automobile starting, lighting and ignition service, Bulletin No. 150 on oil-switch batteries, and Bulletin No. 155 on the latest development in the "Ironclad-Exide" battery.

Electric Fans.—Catalog No. 7000, issued by the Emerson Electric Manufacturing Company, St. Louis, Mo., contains information on its electrically operated fans for the season of 1916. The company has also prepared Bulletin No. 4000, on various types of alternating-current and direct-current fan motors, and Folder Form No. 7020, on its "Northwind" fan motor.

High-Duty Lifting Magnet.—The Cutler-Hammer Clutch Company, Milwaukee, Wis., has prepared a folder printed in colors and entitled "Announcement Extraordinary," which contains information on and illustrations of its large-capacity lifting magnet and its magnetic lockout-type accelerating switches. The folder also contains illustrations of several motor-controller installations.

Fan-Dealer Helps.—The Robbins & Myers Company, Springfield, Ohio, is sending out a folder which contains information on its various helps for dealers in electrically operated fans. The company has also just issued Booklet No. 1083, which is inclosed in an attractively colored cover and describes various types of direct-current and alternating-current fans provided with a cast-iron frame.

New England

BOSTON, MASS.—The Metropolitan Water and Sewerage Board in its annual report advocates the connection of the Wachusetts and Sudbury power stations. The board recommends the erection of a transmission line to connect the two systems, at a cost of $60,000, and also an expenditure of $90,000 for additional improvements.

MERRIMAC, MASS.—The Board of Selectmen has signed a contract with the Amesbury (Mass.) El. Lt. Co. to supply electricity to operate the municipal plant for a period of five years. The local plant will be used for the purpose of pumping the water supply.

MIDDLEBORO, MASS.—The town of Middleboro is considering closing down the municipal electric generating plant and purchasing energy to operate the local system. The question will be decided at a town meeting to be held on March. Should energy be purchased, a 5-mile high-tension transmission line will be erected.

NORWOOD, MASS.—Plans are being made by the City Council to install about 5000 ft. of underground conduit (from six to twelve ducts) this spring.

WESTPORT, CONN.—The Bridgeport Hydraulic Co. has purchased the water rights, electric plant, leases and business of the Westport (Conn.) Wtr. Co.

Middle Atlantic

BALDWIN, N. Y.—Bids will be received by T. D. Smith, secretary, at the office of the board of education, Baldwin, L. I., until Feb. 28 (extension of date from Feb. 15) for construction of Baldwin Public School No. 3. Separate bids to be submitted for heating, plumbing, electrical work and general construction. The cost is estimated at $40,000. Copies of plans and specifications may be obtained at the office of Tooker & Marsh, architects, 101 Park Avenue, New York, N. Y.

BUFFALO, N. Y.—The Public Service Commission has authorized the Salmon River Pwr. Co., Marine Building, Buffalo, to issue $546,000 in bonds, which will be used to complete the financing of its 30,000-hp. hydroelectric power plant on the Salmon River at Orwell, from which it proposes to supply energy to the Solvay substation of the Niagara-Lockport Ontario Pwr. Co.

CALLICOON, N. Y.—The Public Service Commission has authorized the Callicoon Independent El. Co. to issue $1,800 in capital stock, the proceeds to be used for the installation of an electric plant, to be equipped with a 90-kw. dynamo, driven by a steam engine, and a boiler.

COHOES, N. Y.—Bids will be received by the Board of Contract and Supply, Cohoes, until Feb. 15 for lighting the streets of the city for a period of five years from March 1, 1916. The specifications provide for ornamental lamps in the business section. In the other sections of the city the arc lamps now in use will be replaced with incandescent lamps.

COOPERSTOWN, N. Y.—The Colliers Lt., Ht. & Pwr. Co, Cooperstown, has applied to the Public Service Commission for permission to erect transmission lines for the distribution of electricity in Oneonta and for approval of franchise.

DUNKIRK, N. Y.—A bill has been introduced in the State Legislature authorizing the Board of Water Commissioners to extend the water and electric-power service into that part of the town of Dunkirk lying outside of the city, and appropriating $35,000 for the establishment of a fish hatchery there.

FULTON, N. Y.—The Public Service Commission has granted the Fulton Lt., Ht. & Pwr. Co. permission to issue $49,000 in capital stock, the proceeds to be used for extensions to its plant and system.

LOCKPORT, N. Y.—Application has been made to the Public Service Commission by the Lockport Lt., Ht. & Pwr. Co. for permission to acquire the capital stock of the International Pwr. & Trans. Co., amounting to $2,000,000.

MINEOLA, N. Y.—The property and holdings of the Nassau Lt. & Pwr. Co., Mineola, which supplies all the electrical service in Roslyn, Westbury, Glen Cove, Oyster Bay and other places in that vicinity, has been purchased by Hayden, Stone & Co., New York. It is expected that extensions and improvements will be made to the system and service. Charles Hayden has been elected president of the company.

NEW YORK, N. Y.—Bids will be received by Robert Adamson, fire commissioner, eleventh floor, Municipal Building, New York, until Feb. 15 for furnishing electrical fittings and supplies. Blank forms and further information may be obtained at the above office.

NEW YORK, N. Y.—The New York Steam Co., which recently purchased the southerly block in Burling Slip between Pearl and Water Streets, contemplates the erection of a four-story power building, to cost about $500,000. Plans have been prepared by Starrett & Van Vleck, architects, 8 West Fortieth Street, New York.

NEW YORK, N. Y.—The New York Municipal Ry. Corpn. has applied to the Public Service Commission for permission to purchase energy from the Transit Development Co. (which is an affiliated company) at a flat rate of 1 cent per kw.-hr. Under the dual system contracts, the New York Municipal Ry. Corpn. (i. e., the Brooklyn Rapid Transit system) is permitted to suspend for a period of ten years the construction of power houses and to contract with any other company, provided the arrangement is satisfactory to the commission. The commission has notified the New York company that it cannot approve of the contract with the Transit Devel. Co., as it considers the rate too high, and has suggested that the Interborough company supply the service.

NUNDA, N. Y.—The Nunda El. Lt. Co. has been organized to take over the electric-light plant of the Nunda Casket Co. The company will erect several miles of transmission lines, for which wire has already been purchased. A. J. Woodworth has purchased an interest in the company and will act as manager.

ROME, N. Y.—Plans are being considered by the Board of Public Works for the installation of a new street-lighting system, using nitrogen lamps, bids for which will be asked as soon as plans are prepared by City Engineer Plunkitt. Three propositions are under consideration; (1) to ask for bids for 192 nitrogen lamps of 600 cp.; (2) for 195 lamps of 600 cp., 100 of 400 cp., 91 of 250 cp. and 75 of 100 cp.; (3) to ask for the privilege of changing the lamps on any one street should the property owners petition for the ornamental lighting system. The Rome Gas, El. Lt. & Pwr. Co. furnishes electrical service in the city.

TERRYVILLE, N. Y.—The installation of an electric-lighting system in Terryville is under consideration.

WADHAMS, N. Y.—The Wadhams & Westport El. Lt. & Pwr. Co., Wadhams, expects to install a hydraulic governor, rebuild transmission lines and put cement piers under steel conductor pipe. C. R. Payne is owner and manager.

NEWTON HAMILTON, PA.—The installation of a municipal electric-lighting plant and the construction of an electric railway is under consideration. J. W. White, superintendent of the Aetna Explosive Co., is interested in the project.

SOUTH BETHLEHEM, PA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until March 7 for construction complete, including mechanical equipment and approaches, of the United States post office at South Bethlehem, Pa.

WERNERSVILLE, PA.—The Berkshire El. Co., which lately took over the property of the Wernersville & Heidelberg El. Lt. & Pwr Co, will practically rebuild all the lines It is expected that a high-tension transmission line will be erected from McCall's Ferry to supply the new company with energy Samuel Redsecker, Sinking Spring, is superintendent

WILKES-BARRE, PA.—Arrangements are being made by the Wilkes-Barre Co. for the installation of a 3000-kw. turbine and to increase the boiler capacity at the No. 1 station by 2000 hp. E. A. Wakeman is manager.

WILKINSBURG, PA.—The Public Service Commission has approved a contract between the Duquesne Lt. Co., Pittsburgh, and the city of Wilkinsburg for street lighting for a period of five years.

JERSEY CITY, N. J.—Steps have been taken by the West Side Improvement Association for securing an improved street-lighting system on the West Side.

NEWARK, N. J.—Bids will be received by the Passaic Valley Sewerage Commissioners, Essex Building, Clinton Street, Newark, until March 14 for constructing part of Section 4 of the outfall sewerage work, consisting of sedimentation basins, effluent and intake conduits and all appurtenant work, all situated in the city of Newark. Separate bids will be received as follows: (1) Earth excavation and refilling in trench for effluent and intake conduits, 2720 linear ft.; (2) earth excavation and refilling sedimentation basin, Venturi meter chamber, etc.; (3) rock excavation; (4) concrete masonry, class A; (5) concrete masonry, class B; (6) boulder concrete masonry, class C; (7) brick masonry; (8) timber pile; (9) steel for reinforcement; (10) broken stone; (11) surface drains, etc.; (12) gallery piping, etc.; (13) sludge main, etc.; (15) sluicegates, etc.; (16) sluicegates for effluent-controlling house; (17) miscellaneous iron castings; (18) air compressors in administration wing, including all electric wiring, piping, etc., complete and in place; (19) electric wiring and lighting system in sedimentation basin galleries and elsewhere, complete and in place. Drawings, form of contract and specifications, etc., may be obtained from William M. Brown, chief engineer, at the office of the commissioners.

BALTIMORE, MD.—Specifications have been prepared by Harbor Engineer McKay for the proposed hydroelectric power plant to be constructed at Jones Falls Valley.

KENOVA, W. VA.—Arrangements, it is reported, have been completed by the Sanitary Mfg. Co. to acquire the plant of the Independent Steel Co. at Kenova, consisting of five buildings and two power plants, one 100 ft. by 60 ft. and the other 50 ft. by 50 ft., all of heavy brick construction, equipped with sprinkler system. The Sanitary company will build four 24-ft. kilns, install shaving and dust-collecting system; will use two types of conveyors, install foundry equipment, metal-working machinery, hydraulic presses, hydraulic dies, woodworking machinery, accumulaters, heavy duty pumps, gas engines, electric motor and dynamo. The company manufactures sanitary closets, ball cocks, etc. J. H. Davis is general manager.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations the following supplies: Philadelphia, Pa., Schedule 9274—80 steel boiler tubes; Schedule 9279—1500 attachment plugs and 800 sockets. Brooklyn, N. Y., Schedule 9270—6300 lb. brass tubing; Schedule 9279—1000 Leyden jars, 1000 ft. single-conductor wire; Schedule 9274—25,000 ft. telephone wire. Mare Island, Cal., Schedule 9282—5000 ft. telephone cable, five transformers; Schedule 9283—one 15-hp. induction motor. Norfolk, Va., Schedule 9269—one core-wire straightener. Application for proposals should designate the schedule desired by number.

WASHINGTON, D. C.—Proposals in duplicate will be received at the office of the purchasing agent for the Post Office Department, Washington, D. C., until March 6 for furnishing stationery, including paper, wrapping paper, cardboard, blank books, erasers, etc.; typewriters, computing, baling, addressing, numbering, canceling, opening, adding and perforating machines, time recorders, etc.; electrical supplies (motors, carbons, fuses), castings, oils and chemicals, etc., and motor-vehicle supplies, as they may be ordered from time to time during the fiscal year beginning July 1, 1916, and ending June 30, 1917. Blanks for proposals with specifications and instructions to bidders will be furnished upon application to the purchasing agent. A. S. Burleson is postmaster-general.

North Central

DETROIT, MICH.—Extensive improvements and extensions are contemplated by the Detroit Edison Co. during 1916, which will involve an expenditure of about $5,013,893 and will include the construction of a third section at the Conners Creek power house, to cost $1,134,995; substations, $1,039,810; the erection of 270 miles of 23,000-volt cable, $817,125; new meters, $200,000; overhead lines, $408,450; addition to the Delray power house, $360,700; a third central heating plant, $262,500; reconstruction of coaling station, $17,000; improvements at the Farmer Street heating plant, $107,763; Park Place heating plant improvements, $33,400; land for substations, $65,000; improvements at the Washington Avenue and other buildings, $94,450, and $88,000 for improvements to the steam heat-distributing system; other construction expenses are estimated at $145,550. Alex Dow is president.

EAST TAWAS, MICH.—The Council is considering the proposition to sell the municipal electric-light plant to the Consumers' Pwr. Co., Owosso.

HIGHLAND PARK, MICH.—Bids will be received by the Board of Education, High-

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

land Park, until Feb. 24 for construction of an addition to the Willard School building on Hamilton Boulevard between Davison and Waverley Avenues. Bids may be submitted on the entire work or upon any one or more parts or subdivisions, according to plans and specifications now on file with Wells D. Butterfield, architect, David Whitney Building, Detroit. Copies of plans may be obtained upon deposit of $15 for each set of plans. For further information address Caleb S. Pitkin, secretary, 137 Grand Avenue, Highland Park, Mich.

LANSING, MICH.—A new power plant is being erected for the Auto Body Co. on Turner Street. The equipment will be installed within a few weeks.

CINCINNATI, OHIO.—Plans are being made by the West Fifth Street Business Mens' Association for the installation of an ornamental lighting system on West Fifth Street.

CINCINNATI, OHIO.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until March 13 for the installation complete of new hoist-ways, hydraulic mail lifts, etc., in the United States custom house and post office at Cincinnati, Ohio. For details see proposal columns.

CLEVELAND, OHIO.—The El. Ry. Improvement Co., 2070 East Sixty-first Street, Cleveland, it is reported, is contemplating the construction of factory and power buildings on land lying between the Pennsylvania Railroad and East Sixty-first Street.

CLEVELAND, OHIO—Bids will be received at the office of the commissioner of purchases and supplies, City Hall, Cleveland, until Feb. 18 for electric meters for the municipal electric-light department. Specifications may be obtained on application to the office of the commissioner of light and heat division, 1443 East Third Street, Cleveland.

CLEVELAND, OHIO.—O. C. Barber of Barberton, who has a franchise for an electrically operated freight subway under Fifty-fifth Street, Cleveland, has asked Harry L. Davis, Mayor of the city of Cleveland, to consider a proposal to purchase energy for the municipal electric-light plant from a central station to be situated south of Canton, near a coal mine owned by Mr. Barber. The proposed transmission lines would be about 70 miles long. Mr. Barber is founder of large match works, with headquarters in Barberton.

DELPHOS, OHIO.—The Delphos Mfg. Co. has awarded the contract for equipping its entire plant for electrical operation to the Northwestern Ohio Ry. & Pwr. Co., Toledo. The cost of equipping the plant is estimated at $30,000.

HEBRON, OHIO.—The capital stock of the Hebron Lt., Ht. & Pwr. Co. has been increased from $25,000 to $100,000.

SALEM, OHIO.—Contracts have been awarded by the Salem Ltg. Co. to the Riverside Bridge Co., Martin's Ferry, for structural steel work for addition to its power plant on Depot Street. The cost of the extension complete is estimated at about $100,000.

SPRINGFIELD, OHIO.—Preparations are being made by the Springfield Lt., Ht. & Pwr. Co. and the American Tel. & Teleg. Co. to place their overhead wires in the downtown district in underground conduits.

YOUNGSTOWN, OHIO. — Preparations are being made by the Youngstown & Sharon Lt. Co. to place its wires on Federal Street underground.

ZANESVILLE, OHIO.—The trustees of the Bethesda Hospital have been authorized to purchase for the new building a passenger elevator, dumb-waiters, electric-light fixtures, other mechanical equipment, etc.

MIDDLESBORO, KY.—Plans are being considered by the City Commission for the establishment of a municipal electric-lighting plant. Electrical service is now furnished by the Kentucky Utilities Co., Lexington.

BLOOMINGTON, IND.—Bids will be received by the Leonard Springs Water Works Co. until Feb. 24 for improvements to water-works system, including a 14-in. intake from reservoir at Leonard Springs to clear-water well, constructing clear-water well, power plant, including building, furnishing and installing pumping machinery and boilers, and also constructing 17,500 ft. of line. Dr. C. E. Harris is secretary.

MILROY, IND.—An electric-light company has been organized by local citizens for the purpose of installing an electric-light plant if satisfactory terms cannot be made with the Indianapolis & Cincinnati Trac. Co. or the Connersville (Ind.) Lt., Ht. & Pwr. Co. The Witters El. Co., which formerly furnished electrical service here, has discontinued business

WABASH, IND.—Plans and specifications have been prepared by J. R. Cravath, consulting engineer, 140 South Dearborn Street, Chicago, Ill., for the proposed ornamental lighting system for the Commercial Club. The cost is estimated at $10,000.

ASTORIA, ILL.—The Central Illinois Pub. Ser. Co., Astoria, is erecting a 33,000-volt transmission line from Sheldon's Grove to Havana, serving two drainage districts and supplying energy for pumping purposes. Efforts are being made to induce new enterprises to settle in Astoria and other places where power is available. W. O. Falkenstein is local manager.

AURORA, ILL.—The Western United Gas & El. Co., Aurora, is contemplating the purchase of 500 meters, 100 transformers and 5000 incandescent lamps.

BLOOMINGTON, ILL.—The Bloomington & Normal Ry. & Lt. Co. expects to erect a 9-mile transmission line during the coming summer. M. G. Linn is general superintendent.

BLOOMINGTON, ILL.—The city of Bloomington expects to install a 6,000,000-gal. motor-driven centrifugal pump (231-ft. head) in the municipal water-works system. Specifications may be obtained from Fred Evans, city clerk. C. C. Williams is superintendent of water and light plant.

CANTON, ILL.—Improvements are contemplated by the Canton Gas & El. Co., including the erection of a cooling tower, installation of a 2000-kw. turbine with condenser in power house, and the purchase of a 5-ton electric coal truck. The company is now installing a 400-hp. A. & T. boiler, coal bunkers, steam-jet ash-handling system, Wright hopper, coal elevator and Green stoker under boiler. A special campaign will be made in the suburban towns and rural districts to introduce electrical cooking apparatus, etc. E. H. Negley is secretary and treasurer.

DANVILLE, ILL.—The City Council has passed an ordinance calling a special election to submit to the voters the proposal to issue $250,000 in bonds for the installation of a municipal electric-light plant.

GOLDEN, ILL.—The Central Illinois Pub. Ser. Co., Mattoon, has applied for a franchise to erect an electric transmission line from Golden to Clayton. The company has not yet been granted a franchise in Golden, and the construction of a municipal electric plant is under consideration.

HARRISBURG, ILL.—The Southern Illinois Ry. & Pwr. Co., Harrisburg, is reported to be contemplating the construction of an electric railway (60 miles long) to connect Harrisburg with Marion, Johnson City, Herrin and Benton.

JACKSONVILLE, ILL.—The proposal to issue $75,000 in bonds for extensions to the municipal electric-light plant and water-works and to establish a municipal heating system is under consideration by the City Council.

LINCOLN, ILL.—Bids will be received by the Board of Administration, Capitol Building, Springfield, until Feb. 23 for electric-wiring the employees' building, Lincoln State School and Colony at Lincoln. Specifications may be obtained upon application to James B. Dibelka, state architect, 130 North Fifth Avenue, Chicago.

MATTOON, ILL.—At the election to be held in April the proposal to issue $25,000 in bonds, the proceeds to be used to establish an electric-light plant and for improvements to the water-works system, will be submitted to the voters.

PEORIA, ILL.—The Central Illinois Lt. Co., Peoria, has made application to the State Public Utilities Commission for a certificate of convenience and necessity to erect electric transmission lines as follows: Between and in the village of Forsythe and Argenta and in Oreana; to erect a high-tension line from Auburn to Waverly and Roodhouse, and a tap-off from the line at a point west of Waverly, extending to the village of Franklin; to erect and operate a high-tension transmission line from Cartersville to Carbondale; to erect a high-tension line from Windsor west to Tower Hill; from Clayton southeasterly to Mount Sterling and Versailles, for the purpose of supplying electrical service to the two last-named towns.

MADISON, WIS.—Improvements to the water-works at the University of Wisconsin include the purchase and installation of a motor-driven pump and air compressor, together with new building for pumping equipment.

MISHICOT, WIS.—A new boiler and engine are now being installed in the Mishicot light and power plant. The renewal of battery plates is also contemplated. Ira Beyer is president.

CASS LAKE, MINN.—The city of Cass Lake contemplates the purchase of the property of the Cass Wtr., Lt. & Pwr. Co., to be owned and operated by the municipality.

DEERWOOD, MINN. — The Cuyanna Pwr. Co., Deerwood, is reported to be contemplating the construction of another dam on the Pillager River to develop 2000 hp.

MONTEVIDEO, MINN.—The first unit (500 hp.) at the new power plant of the Minnesota Valley Pwr. Co., at Minnesota Falls, will be ready to put in operation in about a month. Preparations are being made by the company to install a new steam plant in Montevideo next summer. The plant will have an output of 2000 hp. and will be used as an auxiliary during low-water periods.

ST. PAUL, MINN.—The Wisconsin-Minnesota Lt. & Pwr. Co., Eau Claire, Wis., is reported to be preparing plans to provide an interurban car service between St. Paul, Minn., and Eau Claire, Wis. Surveys have been completed for a distance of about 75 miles.

ST. PETER, MINN.—Bids will be received by the State Board of Control, State Capitol, St. Paul, until Feb. 23 for construction of an addition to the Criminal Building, State Hospital, at St. Peter. Separate bids to be submitted as follows: General contract work, heating and ventilating, plumbing and electrical work. Plans and specifications may be obtained on application to C. H. Johnston, architect, 715 Capital Bank Building, St. Paul, Minn.

CLARION, IOWA.—The local electric-light plant, owned by Mozingo & Mack, is reported to have been purchased by Elston, Clifford & Co., Chicago, Ill.

FORT DODGE, IOWA—Plans are being prepared by Burns & McDonnell, Interstate Building, Kansas City, Mo., for the construction of a hydroelectric power plant on the Des Moines River. Bids, it is understood, will be asked for about March 1.

MONONA, IOWA.—The State Railroad Commission has granted the Monona Lt. & Pwr. Co. a franchise to erect transmission lines and to supply electricity in territory surrounding Monona and to Luana. The erection of about 3 miles of transmission line is contemplated. Leslie H. Wellman is president and manager.

OSKALOOSA, IOWA—Plans are being prepared for the installation of a power plant for the Oskaloosa Vitrified Brick Co.

ST. ANTHONY, IOWA.—At an election to be held Feb. 21 the proposal to install an electric-light plant in St. Anthony will be submitted to the voters.

STANHOPE, IOWA.—The Henderson Lt. & Pwr. Co., Jewell, has applied for a franchise to supply electricity in Stanhope.

TRAER, IOWA.—Option on the local electric-light plant, owned by F. L. White, it is reported, has been taken by John Reichert. The consideration asked is $36,000.

WEST LIBERTY, IOWA—Extensions are contemplated to the municipal electric-light plant, including the installation of one 100-kw. generator and two 150-hp. boilers; extensions will also be made to street-lighting system. Benton R. Anderson, West Liberty, is engineer.

WOODWARD, IOWA—Bids will be received by the Board of Control of State Institutions, Capitol, Des Moines, Iowa, until March 1 for furnishing steam boilers, engines, generators, feed-water heaters, pumps, switchboards and equipment, wiring, steam heating and alternate hot-water apparatus, all for the State Hospital and Colony for Epileptics, at Woodward, now in course of erection. Plans and specifications are on file in the office of H. F. Liebbe, state architect, Capitol, Des Moines. Copies may be obtained upon deposit of $15. Dr. M. N. Voldeng is superintendent

PIERCE CITY, MO.—The Ozark Pwr. & Wtr. Co., Branson, is contemplating extending its transmission lines from its plant at Powersite to Pierce City to furnish electrical service. Application will be made by the company for a franchise in Pierce City. This city is now served by a municipal plant.

ST. JOSEPH, MO.—Plans are being prepared by the Western Tablet Co., Eleventh and Mitchell Streets, St. Joseph, for remodeling its factory and power plants. The plans provide for the installation of a 100-hp. oil engine and remodeling batteries for lighting system, etc. F. B. Daggett, 614 North Fifth Street, St. Joseph, is engineer.

ENDERLIN, N. D.—Bids will be received by the Board of Education of Enderlin, at the office of E. T. Danielson, clerk of board, Enderlin, until Feb. 25 for construction of addition to and remodeling present school building, including general construction, heating and ventilating, heat regulation, plumbing and wiring, in accordance with plans and specifications prepared by John D. Chubb, architect, 109 North Dearborn Street, Chicago, Ill. Copies of plans may be obtained upon application to the architect and at the office of the clerk of the school board, Enderlin.

LESTERVILLE, S. D.—The installation of a municipal electric-lighting plant in Lesterville is under consideration by local business men.

NEWELL, S. D.—The Board of Trustees is considering the installation of an electric-lighting system in Newell.

KEARNEY, NEB.—The City Council is considering a proposal submitted by the Kearney Wtr. & El. Pwr. Co. to operate the municipal water-works pumping station by electricity.

AMERICUS, KAN.—The installation of a municipal electric-lighting plant in Americus is under consideration.

CHANUTE, KAN.—Contract will soon be awarded by the City Commissioners for motor-driven pumps, 27 blocks of service water lines, water regulators and 205-kva. engine-driven generators at the municipal lighting plant. C. G. Wood is city clerk.

CIMARRON, KAN.—The installation of an electric-lighting system in Cimarron is under consideration. It is proposed to erect a transmission line from Garden City, which will also supply electricity to ranches along the line. In case the line is built the towns of Pierceville and Ingalls will be asked to take electrical service.

FRANKFORT, KAN.—The installation of an ornamental street-lighting system in Frankfort is being promoted by the Community Club. The plans provide for the erection of 44 single-lamp standards, maintained by underground wires. The local telephone company will bear half of the expense of the underground conduits and place all of its wires in the same conduit. F. C. Dwinnell is owner of the local electric plant.

HOYT, KAN.—The city of Hoyt is negotiating with the Topeka Edison Co., Topeka, for commercial electrical service. If satisfactory arrangements are made, a transmission line will be erected from Topeka to Hoyt, and a distribution system will be installed here.

MINNEOLA, KAN.—The City Council is negotiating with the Midland Wtr., Lt. & Ice Co., Dodge City, to suply electricity for commercial purposes. If satisfactory arrangements are made, a transmission line will be erected from Dodge City to Minneola and a distribution system installed in Minneola.

MORLAND, KAN.—The City Council is considering calling an election to submit to the voters the proposal to issue bonds for the installation of an electric-light plant.

OTTAWA, KAN.—Bids will be received at the office of the city clerk, Ottawa, until Feb. 15 for furnishing and installing an ornamental street-lighting system on Main and Tecumseh Streets, consisting of 76 single-lamp standards and four traffic-way posts, to be 18 in. shorter than the curb posts. The lamps are to be maintained by underground wires.

Southern States

CHARLOTTE, N. C.—The Southern Pwr. Co., Charlotte, is reported to be contemplating the construction of a hydroelectric power plant on Johns River near Collettsville.

GASTONIA, N. C.—A new street-lighting system is now being installed in the business section, consisting of 63 lamp standards mounted with one 600-cp. lamp. H. Rutter is superintendent of the municipal electric plant.

SALUDA, S. C.—A franchise has been granted to F. A. Hugh, Atlanta, Ga., to install and operate an electric-lighting plant in Saluda for a period of 20 years.

ACWORTH, GA.—Artesian wells are now being drilled in connection with the municipal electric-light plant and water-works system. An air-lift will soon be installed. W. G. Crogan is chairman of water and light committee.

BLAKELY, GA.—Improvements will soon be made to the municipal electric-light plant, including the installation of an Ingersoll-Rand compressor (motor-driven, 200 cu. ft. per square inch), for which contract has been placed. The installation of either a motor-driven or a steam-turbine-driven centrifugal pump, having a capacity of from 500 to 600 gal. per minute under a 150-ft. head, is under consideration. Machinery not yet contracted for. E. R. Adams is superintendent.

ROME, GA.—The Rome Ry. & Lt. Co. has recently completed the erection of a 2300-volt transmission line to various parts of the city and suburbs to supply energy for power purposes only. H. J. Arnold is superintendent.

STATESBORO, GA.—Improvements will be made to the municipal electric-light plant this spring, including the installation of a 250-hp. boiler with stokers and other equipment. A few more lightning arresters will probably be purchased. Daniel R. Gould is superintendent of light and water plant.

VILLA RICA, GA.—The Villa Rica El. Lt. & Pwr. Co. is contemplating the installation of an 80-hp. high-pressure boiler. The company would like to receive prices on a second-hand boiler; must be in good condition and stand Hartford inspection; R. D. Cole boiler preferred. W. B. Powell is general manager.

LAKE WORTH, FLA.—The Lake Worth Lt., Wtr. & Ice Co. expects to install an internal-combustion engine, generator and exciter, with switchboard, and will require material for approximately 20 miles of line work. Ward Randolph is superintendent.

PUNTA GORDA, FLA.—The city of Punta Gorda expects to install a series street-lighting system in the near future. R. L. Morgan is superintendent.

KNOXVILLE, TENN.—Investigations are being made by the City Commission relative to the cost of the installation of a municipal electric-light plant. The cost is estimated at $200,000.

ALABAMA PORT, ALA.—The Tidewater Securities Pwr. Co., Mobile, is planning to build an electric-light plant and extend the water-works system in connection with its proposed development at Alabama Port. J. M. Dewberry is president.

BIRMINGHAM, ALA.—A tentative proposal has been submitted to the city of Birmingham by J. S. Pevear, president of the Birmingham Ry., Lt. & Pwr. Co., relative to the construction of an electric railway from this city to Warrior River, a distance of 20 miles, to give the shippers in Birmingham direct communication with water transportation. The cost of the proposed railway is estimated at $300,000.

DECATUR, ALA.—The city of Decatur has engaged Xavier A. Kramer, Magnolia, Miss., consulting engineer, to prepare plans and specifications for the construction of a municipal electric-light plant, to cost about $40,000.

WOODVILLE, OKLA.—The City Council is considering calling an election to submit to the voters the proposal to issue $8,000 in bonds for the installation of an electric-light plant and $15,000 for water-works system.

AMARILLO, TEX.—The City Lt. & Wtr. Co. is planning to change the service pumps for supplying water to the city from compound duplex pumps to directly connected electrically driven centrifugal pumps. G. W. Faller is general manager.

BALLINGER, TEX.—The local electric-light plant, owned by the Ballinger Cotton Oil Co., has been purchased by the Interstate El. Corpn., 115 Broadway, New York, N. Y. The plant, it is understood, will be enlarged and transmission lines extended to other towns in this section.

COMANCHE, TEX.—The local electric-light plant has been purchased by the Texas Pwr. & Lt. Co., Brownwood, which will erect a transmission line from Brownwood to Comanche via Blanket.

LOCKHART, TEX.—The Citizens' Wtr., Lt. & Pwr. Co. is reported to have engaged Henry Elrod, Southwestern Life Building, Dallas, engineer, to prepare plans for the construction of an electric-light plant, ice factory and water-works system in Lockhart.

SULPHUR SPRINGS, TEX.—B. F. Ashcroft & Sons, owners of the local electric-light plant, are extending the street-lighting system. Improvements, it is understood, will also be made to the plant.

Pacific States

PORT ANGELES, WASH.—Bonds to the amount of $30,000 authorized for extensions to the municipal electric-lighting system have been sold. Bids for material and installation, it is reported, will be asked for at an early date.

SEATTLE, WASH.—Bids will be received by the Board of Public Works, Seattle, until March 3 for the construction of a steel bascule bridge, including the construction of the concrete substructure with steel superstructure, operating machinery and electric equipment at Eastlake Avenue over Lake Washington Canal. A charge of $5 will be made for each set of plans and specifications to cover the cost of printing and mailing. C. B. Bagely is secretary.

PORTLAND, ORE.—Bids will be received by the City Council until Feb. 18 for general contract for the construction of the public auditorium. At a later date proposals will be received for electric wiring of the building.

GILROY, CAL.—The Coast Counties Gas & El. Co., Gilroy, which operates the municipal electric-lighting system under lease, will install a new street-lighting system, consisting of 36 4-amp. lamps erected on ornamental standards; will also install a General Electric 4-amp. 50-lamp series mercury rectifier and transformer.

MARTINEZ, CAL.—The Western Pwr. Co., San Francisco, contemplates the construction of a central power station in Martinez; also the erection of a 100,000-volt electric transmission line along the Costa Contra shore from Antioch to Richmond.

SEAL BEACH, CAL.—The City Trustees are contemplating calling an election to submit to the voters the proposal to issue bonds for water, lighting and sewer systems in Seal Beach.

RATHDRUM, IDAHO.—The controlling interest of the Rathdrum El. Co., which supplies electrical service in Rathdrum and Post Falls, has been purchased by F. M. Shields of the Shields Investment Co., Old National Bank Building, Spokane. Improvements will be made to the plant at once, and extensions to the service will be made during the coming year. B. E. Kyle, Rathdrum, is temporary manager.

SODA SPRINGS, IDAHO—Improvements will be made to the municipal electric light plant, including the installation of a 250-hp. waterwheel with governor, one 150-kva., three-phase, 60-cycle, 2300-volt generator, with exciter, switchboard and arresters, for which contracts have already been placed. The village is in the market for 115 ft. of 36-in. wood-stave pipe, 2 miles of No. 6 double-braided, weather-proof wire, cross-arms, insulators, hardware for 2300-volt pole line, and for 12 five-lamp ornamental standards and equipment for same. It is proposed to establish a special rate for cooking service soon; the sale of a number of motors, ranging from ½ hp. to 5 hp., is also under consideration. Alvin Meyers is superintendent and engineer.

CASA GRANDE, ARIZ.—At an election to be held Feb. 15 the proposal to issue $35,000 in bonds for the construction of an electric-light plant, water-works and ice factory will be submitted to the voters. Sidney F. Mashbir, Tucson, is engineer.

GLENDALE, ARIZ.—The Council has granted a franchise for the installation of an electric-light and power plant and water-works system in Glendale.

MESA, ARIZ.—The Grand Prairie Canal Co., recently incorporated, it is reported, will begin work immediately on the construction of a 28-mile irrigation canal to provide water from White River to develop the rice-growing industry. A pumping station will be erected on White River.

BUTTE, MONT.—Plans are being considered by the Montana Pwr. Co., Butte, it is reported, for the construction of a dam and power plant at Holter, about 30 miles from Helena. The cost of the proposed plant is estimated at from $3,000,000 to $3,500,000. F. M. Kerr, Butte, is general manager.

ROUNDUP, MONT.—Plans are being prepared for the installation of a new lighting system for the business section, to cost about $10,000. The plans provide for the erection of 122 standards carrying cluster lamps.

Canada

HALIFAX, N. S.—The City Council has adopted the recommendation of the committee that the Halifax Pwr. Co. be awarded the contract for lighting the city at a cost of $30,000 per year, for a period not to exceed 25 years.

AMHERSTBURG, ONT.—Plans are being considered by the Town Council for extensions to the present lighting system. Later the question of installing a permanent lighting system will be taken up.

HAMILTON, ONT.—The City Council has authorized the installation of a new storage-battery signal system at the central police station.

MONTREAL, QUE.—The Montreal Pub. Ser. Corpn., it is reported, is contemplating extensions to its power plant.

Mexico

HOQUILLA, CHIHUAHUA, MEXICO.—The Mexican Northern Pwr. Co., Santa Rosalia, it is reported, will soon resume work on its large power project in Hoquilla. The dam across the Conchas River has not been harmed, and the hydroelectric power plant and transmission system will be built as soon as possible.

Miscellaneous

PANAMA—Bids will be received at the office of the chief purchasing officer, the Panama Canal, Washington, D. C., until Feb. 14 for furnishing, under File 2363-E, 32 condulets and 72 stuffing boxes. For further information address Major F. C. Boggs, general purchasing officer.

PANAMA—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until Feb. 26 for furnishing nickel chrome dipper teeth, transformers, panelboards, watt-hour meters, electric fans, reflectors, electric switches, electric fittings, galvanized conduits and fittings, screwdrivers, pliers, wire solder, white fiber, sheet rubber, rubber rods, insulating tape, stay binding, electric cable and wire as per Circular No. 1013. For details see proposal columns.

PANAMA—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until Feb. 24 for furnishing Scotch marine boiler, steel shapes, plates and bars, steel billets, cold-rolled steel, tire steel, steel wire, steel or iron chain, sheet brass, copper rivets and burrs, brass rivets, telephone receptacles, marine lamps, electric griddle plates, etc. Blanks and general information relating to this circular (No. 1012) may be obtained from the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and Fort Mason, San Francisco, Cal.

Record of Electrical Patents

Notes on United States Patents issued Feb. 1, 1916, prepared by Mitchell & Allyn, 41 Park Row, New York.

1,169,788. Secondary or Storage Battery; Bruce Ford, Philadelphia, Pa. App. filed May 9, 1914. Improved connection between jar and cover.

1,169,798. Lug; R. A. Goeller, New York, N. Y. App. filed Sept. 9, 1914. Detachable ornamental cap applied to cable terminal lug.

1,169,799. Machine-Switching Telephone-Exchange System; C. L. Goodrum, New York, N. Y. App. filed July 23, 1915. Two-wire system wherein two relays only are required to control the selector.

1,169,800. Machine-Switching Telephone-System; C. L. Goodrum, New York, N. Y. App. filed Sept. 16, 1915. Finder is restored if it fails to function properly.

1,169,817. Method of Carrying Out Gas Reactions in an Electric Furnace; A. Helfenstein, Vienna, Austria-Hungary. App. filed Nov. 18, 1911. Low-tension furnace with fused granular resistance charge between hanging electrodes.

1,169,824. Apparatus for Electrically Treating Air; W. T. Hoofnagle, Glen Ridge, N. J. App. filed April 23, 1915. Recovery of nitrogen oxides.

1,169,825. Method and Apparatus for Making Ozone; W. T. Hoofnagle, Glen Ridge, N. J. App. filed April 23, 1915. Rapid surging of air under treatment.

1,169,827. Electrical Stove; G. A. Hughes, Chicago, Ill. App. filed April 14, 1915. Toy size; fully operative.

1,169,851. Gas Lighter and Extinguisher; Howard G. Mead, Shrewsbury Park, Mo. App. filed Dec. 2, 1914. Distance control applicable to ordinary gas-lighting system.

1,169,865. Contact Shoe for Third-Rail Electric Cars; C. F. Raydure, West Philadelphia, Pa. App. filed June 14, 1915. Cast in two members, rendering subsequent machining unnecessary.

1,169,866. System for Supplying Electricity; I. J. Reuter, Anderson, Ind. App. filed Oct. 19, 1912. Ignition and lighting of automobiles.

1,169,878. Control Apparatus; K. A. Simmon and A. J. Hall, Wilkinsburg, Pa. App. filed June 20, 1914. Operating mechanisms for plurality of electric rheostats as used on electric locomotives.

1,169,885. Vehicle Signal; J. F. Sullivan, New York, N. Y. App. filed June 3, 1914. Pedal-controlled shutters over signal lamps.

1,169,890. Selector Switch; L. von Nagy, Plainfield, N. J. App. filed Aug. 25, 1915. Improved means controlling activity of several brush sets.

1,169,893. Apparatus for Use in Producing Synthetic and Chemical Substances; J. R. Watson, Baltimore, Md. App. filed Jan. 25, 1915. Electrically heated retort of novel form.

1,169,894. Automatic Telephone System; H. G. Webster, Chicago, Ill. App. filed Feb. 27, 1907. Improved circuit structures. (Eighty-two claims.)

1,169,932. Electric-Fixture Attachment; S. E. Cressey, San Pedro, Cal. App. filed Oct. 6, 1914. Applicable to the side posts of a bureau or dresser.

1,169,937. Electrical Device for Changing the Direction of Rotation of Shafts; M. J. Dikeman, Detroit, Mich. App. filed June 30, 1913. Provides instant reversal of motion.

1,169,942. Arc-Light Electrode; G. Egly, Treptow, near Berlin, Germany. App. filed April 22, 1910. Calcium oxide and rare earth oxide of the cerium group.

1,169,943. Colloidal-Manganese Dioxide Depolarizer; C. Ellis, Montclair, N. J. App. filed Oct. 23, 1915. Non-colloidal-manganese dioxide bonded by colloidal-manganese dioxide material.

1,169,949. Cable Construction; B. W. Gates, Washington, D. C. App. filed March 23, 1914. Filling material of twisted paper.

1,169,957. Circuit-Controller; W. S. Henry, Rochester, N. Y. App. filed Oct. 23, 1912. Inclosed and positively adjustable.

1,169,960. Device for Mounting Electric Wires; G. P. Jacobson, Lanse, Pa. App. filed July 3, 1915. Mounting trolley-feed wires.

1,169,991. Electric Signaling System; W. C. Neahr, Denver, Col. App. filed Oct. 14, 1913. Includes visible and audible signals.

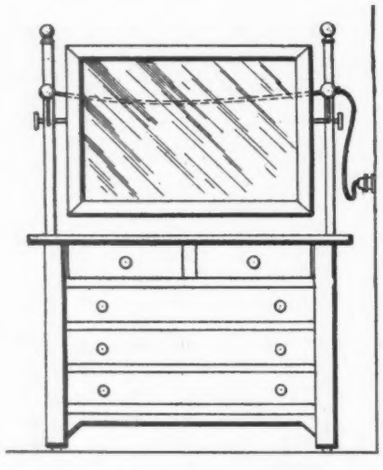
1,169,992. Circuit-Controlling Instrument; W. C. Neahr, Denver, Col. App. filed May 11, 1914. Operated by vibrating element on track.

1,170,000. Insulating Enamel; F. A. Robinson, Auburn, N. Y. App. filed Nov. 7, 1914. Residuum of oil from pinnipedic or cetaceous animal (walrus oil).

1,170,012. Portable Electric Searchlight; R. L. Smith, Everett, Mass. App. filed Sept. 18, 1914. Light, powerful design.

1,170,017. Fault Locater for Electric Cables; H. M. Stoller, New York, N. Y. App. filed Dec. 24, 1913. Particularly for telephone cables.

1,170,032. Lock for the Gates of Elevator Shafts; W. A. Williams, Barton, Ohio. App. filed April 19, 1915. Normally maintained lock.



1,169,932—Electric-Fixture Attachment

1,170,033. Circuit Controller; M. Wuerpel, Rochester, N. Y. App. filed May 18, 1915. Permits quick and easy adjustment of drum contacts.

1,170,063. Circuit Closer; H. J. Heeney, Roxbury, Mass. App. filed Nov. 17, 1910. Push-button for hospital signal systems.

1,170,112. Service and Meter Testing and Connection Blocks; J. Sachs, Hartford, Conn. App. filed Dec. 14, 1914. Bypass bridge for meter testing. (Fifty-two claims.)

1,170,113. Electric-Meter Testing Switch; J. Sachs, Hartford, Conn. App. filed March 12, 1915. Adapted for use with any standard service arrangement.

1,170,143. Railway Signaling System; A. Dulac, Gardiner, Me. App. filed May 7, 1913. For railway crossings.

1,170,165. Electrical Heating Unit; F. Kuhn, Detroit, Mich. App. filed March 6, 1911. Particularly for sadirons.

1,170,166. Electrical Heating Unit; F. Kuhn, Detroit, Mich. App. filed June 28, 1913. Particularly for air heaters.

1,170,167. Terminal Contact Plug; F. Kuhn, Detroit, Mich. App. filed Sept. 8, 1913. Electrically and mechanically protected for heaters.

1,170,168. Connector for Electrically Heated Instruments; F. Kuhn and F. E. Shailor, Detroit, Mich. App. filed July 9, 1914. Designed for sadirons.

1,170,169. Electrical Food Warmer; F. Kuhn and F. E. Shailor, Detroit, Mich. App. filed April 19, 1915. Particularly for infants' food.

1,170,170. Electrically Heated Glue Pot; F. Kuhn and F. E. Shailor, Detroit, Mich. App. filed April 13, 1915. Water-jacketed.

1,170,184. Separation of Liquid Suspensions; F. W. Peek, Jr., Schenectady, N. Y. App. filed Feb. 18, 1913. Separation of suspended water from oil.

1,170,190. Electric Switch; F. J. Ravlin, Chicago, Ill. App. filed April 3, 1911. Weatherproof plug-switch connection.

1,170,192. Cooling Dynamos; R. Rudenberg, Charlottenburg, and A. Zehrung, Berlin-Wilmersdorf, Germany. App. filed July 13, 1915. Hollow conductors for cooling purposes.

1,170,196. Controlling Mechanism for Automobile Starting Motors and Lighting Generators; G. E. Stevens, Lynn, Mass. App. filed Jan. 11, 1915. Prevents mistakes in operation of the starting mechanism.

1,170,201. Transformer; J. M. Weed, Pittsfield, Mass. App. filed Aug. 7, 1912. Improved ventilation and mechanical strength.

1,170,211. Split-Phase System; E. F. W. Alexanderson, Schenectady, N. Y. App. filed Jan. 29, 1914. Working potential increased by special arrangement of secondary windings of transformer and winding of phase converter.

1,170,247. Anticathode for Roentgen-Ray Tubes; M. Gundelach, Gehlberg, Germany. App. filed April 21, 1915. Metallic uranium.

1,170,260. Lightning Rod; A. G. Hoovens, Goshen, Ind. App. filed April 1, 1915. Means for compressing point portion on line conductor.

1,170,275. Ignition System; C. F. Kettering, Dayton, Ohio. App. filed Nov. 8, 1910. Applicable to a wide range of primary voltage.

1,170,287. Method of Making Insulators; J. S. Lapp, Victor, N. Y. App. filed Jan. 2, 1914. Suspension type.

1,170,313. Process of Burning Carbon Electrodes; F. Nagelschmitz, Munich, Germany. App. filed Feb. 15, 1915. Volatile constituents of the tar collected and used for heating furnace.

1,170,323. Telephone-Signal Operating Device; F. E. Phillips, Wells, Me. App. filed Nov. 12, 1912. Light in circuit when receiver is lifted off hook.

1,170,347. Means for Operating Switch Mechanism; R. A. Schoenberg, New York, N. Y. App. filed Feb. 9, 1914. Does away with protruding actuators.

1,170,356. Telephonic Apparatus; H. Smith, Copenhagen, Denmark. App. filed Nov. 14, 1914. Granular carbon microphone.

1,170,360. Holding Device; J. D. Taylor (deceased), Wilkinsburg, Pa. App. filed Aug. 28, 1912. For railway signals.

1,170,361. Railway Signal; J. D. Taylor, Edgewood Borough, Pa. App. filed Aug. 28, 1912. Operated by electric motor.

1,170,362. Railway Signal; J. D. Taylor, Edgewood Borough, Pa. App. filed April 2, 1913. Squirrel-cage rotor; motor construction.

1,170,388. Electrical Contact; H. Anschutz-Kaempfe, Neumuhlen, near Kiel, Germany. App. filed Sept. 7, 1911. Constructed to prevent loss of mercury.

1,170,407. Testing Device for Spark Plugs; W. Brown, Oglesby, Ill. App. filed Nov. 17, 1914. Of convenient size for handling and storing away.